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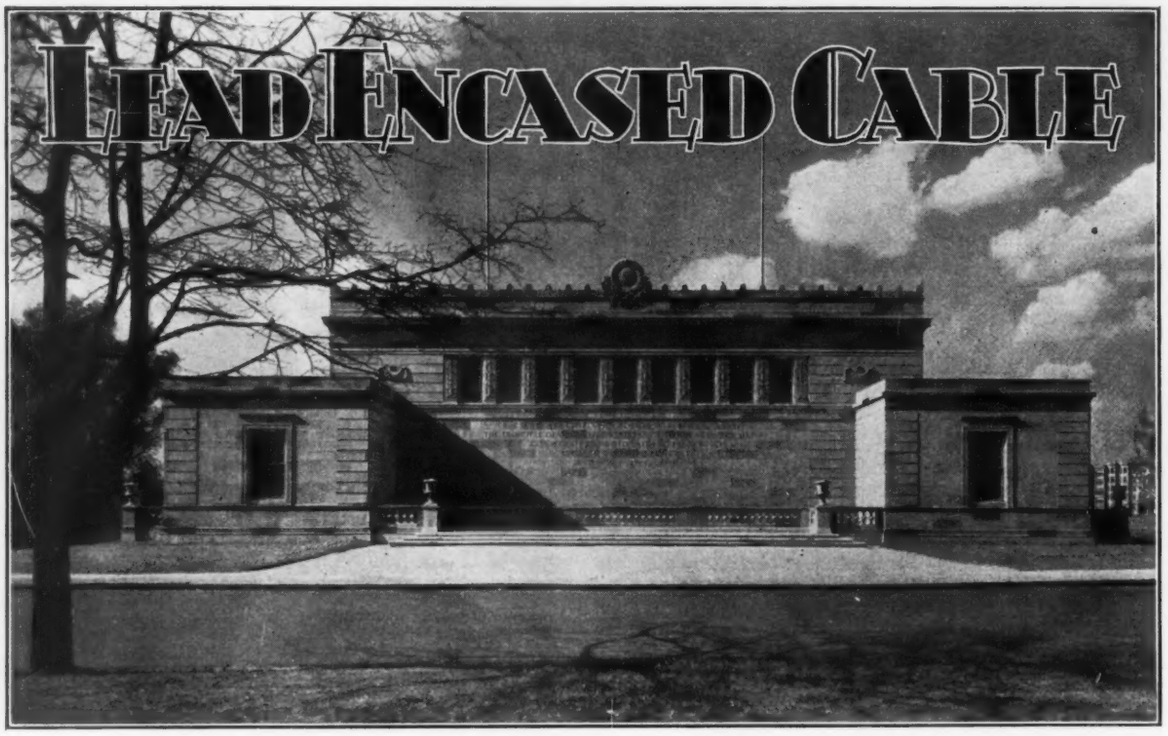

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VOLUME 93 — *New York, Saturday, March 30, 1929* — NUMBER 13

To Celebrate the "Golden Jubilee of Electric Light"

THIS country is going to be bathed in a blaze of golden light during the summer. A nation-wide celebration of the "golden jubilee of electric light" will be inaugurated at the convention of the National Electric Light Association in Atlantic City and will reach its climax in October with simultaneous celebrations throughout the country.

Electric light is probably the greatest boon modern science and industry have contributed to mankind, and it is eminently fitting that the fiftieth anniversary of Edison's incandescent lamp should be the occasion for widespread jubilation. All interests in the electrical industry are behind the program, and almost unlimited talent, equipment and funds are said to be available.

The coming dedication of the new auditorium in Atlantic City at the N.E.L.A. convention has prompted the full co-operation of the local officials in plans to make the convention city a place wherein electric light and electric lighting effects will be of unrivaled brilliancy and beauty. With Atlantic City as a sample in June, it is expected that other cities will prepare similar decorative lighting for the culminating celebrations in October. The cause is worthy, the objects are non-commercial, and all electrical men should do their part in making the golden jubilee of light an occasion of historic value.

* * * *

Utilities and Engineering Colleges

ENGINEERING education is expensive and students seldom pay more than a portion of the cost. Nor have men of wealth realized the opportunities to help the progress of this country by providing large endowments for engineering education and research. As a result most of the engineering schools are financially starved and many have need of outside financial help.

For several years the utilities have been active in helping engineering schools. Aid has taken the form of scholarships, donations of equipment, funds for research, co-operation in testing and some part-time employment of professors and students. Recently, however, this co-operation has shown a tendency to decrease, and the reason lies largely in the reaction of utility executives and educational executives to the publicity developed by the Federal Trade Commission's investigation of utilities. There is a fear that any degree of co-operation will be misunderstood and that suspicion and misunderstanding will develop.

The engineering colleges and the utilities need each other. They can be helpful to each other in many ways, and there should be no difficulty in reaching a complete understanding of ethical methods of co-operation. Engineering educators need the intimate contact with utility equipments, engineers and engineering problems in order to vitalize their work and to keep up with a rapidly changing art. Students get great value from inspections and tests of utility equipments, and co-operative lectures to utility and college groups bring to both points of view and information of great value. Utility men can get help and instruction from the expert technicians and educators found in the engineering schools and in return can contribute to the educational proficiency of the schools. There is a mutual obligation to discharge and a mutual benefit to be obtained, and a little clear thinking and courage should be used to insure the desired end. Too much is at stake to let fear of misunderstanding replace trust and co-operation.

* * * *

Industrial Leadership in the Southeast

THE so-called industrial empire of the Southeast presents an interesting problem that is worthy of close study by the power companies of that section. This is the mountain and Piedmont country of southern West Virginia, southwestern Virginia, western North and South Carolina, northern Georgia and Alabama and eastern Tennessee. It is an area that disregards state lines. It finds its fundamental unity in its major natural resources. Among them labor, climate, power and transportation stand paramount, but the greatest of these is found in the fact that this mountain country provides the last stronghold of undiluted Anglo-Saxon labor in the United States. For there are tens of thousands of these mountain people ready today to work in the modern factory that provides a better livelihood than the hillside corn patch has afforded. And to a growing diversity of industries this labor is now proving itself both efficient and dependable.

In the North and East and Middle West there has long been a tradition prejudiced against the South. Men have believed that the climate is enervating, that only low-grade negro labor is available and that the country and its people are poor and unprogressive. But times have changed. This Southeastern country especially is now prospering and enjoying a material and cultural development that is as appealing as anything the nation has seen. Industry is its natural expression. For, in addition to labor, there is a mountain climate, a short winter, coal, iron and other minerals, good railroads and highways, and a most progressive power development. And naturally this awakening population has found courage and confidence in these facts and is building fine cities with fine homes and schools. It is establishing balanced industries and inviting the manufacturers of industrial America to come and prosper with them.

Charleston, Charlotte, Atlanta, Birmingham, Chattanooga—the voice of the cities is heard in the land.

But, as is always the case, these voices of the cities are in violent competition. The stranger discounts their enthusiastic claims and wonders which is really the best location for his plant. He wishes that he might have a broader and less local picture of the vital resources of this rapidly advancing region. And he should have. There is need for a more co-ordinated leadership in the development of this new industrial empire in the Southeast. Some part of the funds that are now promoting the rival cities should be appropriated to tell the romantic story of this mountain country—its labor, its climate, its power, its transportation, its other natural wealth.

It would seem that the power companies stand in a particularly favorable position to carry the banner in such a movement. They are not directly competitive. Each can afford to work for the entire section and take its share in the industrial growth that results within reach of its lines. The railroads should also be glad to contribute and would profit equitably. The effort would immeasurably increase the interest and understanding in the North. It is an opportunity for public service that should appeal to every Southeastern utility executive.

* * * *

Economic and Service Elements in Large Turbo-Generators

GENERATING units have grown in size and efficiency very rapidly. In large systems the reasons are obvious. For example, the 160,000-kilowatt unit for Hell Gate described in this issue gives a rating of more than 55 kilowatts per square foot of floor area as contrasted with an original layout for a 30,000-kilowatt unit that gave a rating of only 10.4 kilowatts. These large units also require only about 8 to 10 tons per kilowatt of capacity as against requirements as high as 25 to 30 tons for smaller units. Incidental savings occur in the way of total cost of installation per unit of capacity, although no material gain is made in thermal efficiency.

But the true gage of value for any generating unit is the total cost of each unit of energy produced, and this is influenced very largely by the requirements for the periodic shutdown of equipment for maintenance and the probable loss of revenue as a result of breakdowns. In these respects the large units are yet to be evaluated. No inherent differences in reliability are found between large and small units except possibly in shaft shrinkages and warpings, but the aggregate figure for shutdowns, in capacity, is large, because, like a mammoth egg, the large unit must necessarily, so to speak, be carried in one basket. Only time and experience will permit reliability comparisons to be made accurately.

It is also interesting to study the influence of the use of large units on the reserve capacity needed on a system, especially since interconnected systems are now so prevalent. In some systems it has been the custom to maintain a reserve based on a constant percentage to total generating capacity, while in others the practice is to provide reserve sufficient for the protection of the largest unit. It is yet to be proved that either of these practices is adequate for new conditions on interconnected systems with very large generating units. Further work must be done in the economic evaluation of all these elements in terms of minimum cost of reliable service.

Finding Power Outlets Through Tie-Line Service

INTERCOMPANY and interdivisional tie lines deserve engineering and commercial scrutiny from time to time in order that such circuits may be operated to maximum advantage from the standpoint of the regional power market. A 40-mile, 33-kv. interconnection between the Burlington and Montpelier districts of Vermont offers a case in point. Originally this line connected two power companies under separate managements, and it was particularly useful in handling a portion of the day load in the Montpelier-Barre quarries. Recently the Green Mountain Power Corporation absorbed the Burlington and Montpelier companies. The interconnection contract gave way to routine daily operation under a single management, with the result that in seven months' service the hydro-electric plants in the Burlington district increased their output by 6,000,000 kilowatt-hours over the 1927 figures, a gain of 33⅓ per cent.

Thus the resources of one district were made more readily available to the other and a market for water power which would have been wasted at certain periods and times of day without free and co-ordinated use of facilities was developed. Common owership of plants and lines brought about a grade of interconnected service which had not been realized under the separate régimes, and this pooling of facilities was advantageous to industries in each district. More complete use of the plant investments in hand tended to cut down the amount of fuel consumed in the steam stations allied with the hydro plants. The instance is, of course, far from unique, but it points to the value of arranging for more intensive service on tie lines where the regional power market is capable of absorbing surplus or other low-cost energy.

* * * *

Magnetic Linkage of Systems to Reduce Short-Circuit Values

MAGNETIC connections for sources of energy are growing in favor because they keep down energy values under fault conditions. Installations of transformers and generators are now in process wherein two or more separate windings are used and connected to separate bus sections so that the buses are connected magnetically to each other. Plans have also been made to use three-winding transformers to feed transmission substations wherein the two primary windings are connected to separate generating sources. In the extreme case a common magnetic core could be used to connect magnetically several generating sources to several load centers. The major advantages accrue from cost reductions arising from a reduction in the short-circuit energy concentration and from savings caused by some decrease in the possible number of service interruptions.

But there are definite limitations to the use of the magnetic coupling principle. A two-way transfer of energy between interconnected systems can be had only with great difficulty, and specific problems of unbalance and impedance are difficult to solve. Impedance values necessary for the best design of the transformer may be far out of line with the values desirable on the electrical systems on which the transformer is used, and the effects of unbalanced loads are very serious. But the magnetic-coupling principle has very decided advantages for large

generators and for special transformer applications, and there is no doubt that this principle will be utilized to the ful'est extent compatible with operating and design limitations.

* * * *

What Constitutes a Utility System?

GROWING complexity in the ownership and control of some of our utility systems suggests a definition of terms to cover new situations. Most investors and most consumers of service ask few questions. But they do expect some clear idea of where control of any particular group lies and concerning the geographic bounds of its operations.

To illustrate: A certain utility system, A, recently purchased a corporation, B, thereby securing a majority of the voting stock of a second system, C, along with a management contract covering its operations. In its published statements system A designates its new gross revenue, assets and power output as that of the two systems combined. But incidentally another utility system, D, has gradually been acquiring an interest in system C and is reported to have secured about 75 per cent of its entire holdings, including a minority interest in its voting stock and all of its non-voting common stock.

There is no criticism of the transaction. It is eminently legitimate. But it does emphasize the fact that a clear-cut definition of terms in this regard becomes more and more imperative as the consolidation movement proceeds. Otherwise the bewilderment which must result cannot but have an adverse bearing upon public relations. It is difficult to have confidence in and lend one's support to a system which one cannot identify.

* * * *

The Day's Work and Tomorrow

ENGINEERING and economy are almost synonymous terms. The engineer, being a pre-eminently practical man, recognizes that a project must pay its own way. Where the idealist would plead that "only the best is good enough," the engineer works for dollar values. A power plant, a motor car, an office building or a watch that will last indefinitely is not economically worth while, for the design will be obsolete or inadequate long before wear and tear or the disintegration of age have robbed it of useful value. But the demands of the dollar must not temper the engineer's enthusiasm for the best.

The policies of the electric light and power industry, like those of other contemporary business, are inextricably bound up with the banking, commercial and engineering world of today. An intelligent engineer must play the game that is being played as a part of a team and not as an individual star. The demands of the future must be subject to the exigencies of the present, but the future is always an indeterminate distance away and cannot govern the action of today. Maybe tomorrow, or next year, or ten or twenty years hence, power stations will be something more than crude burners of quantities of raw coal; substations will be unthinkable as assemblies of inartistic steel members; the use of century-old trees for transmission-line supports will be uneconomical; utilities will no longer be forced by economic reasons to tolerate open wire construction on front lawns, along fine residential streets and through lovely shade trees; the public will distinguish between information and propaganda from every enterprise that seeks to tell the facts of its business to the rest of the world. The engineer can help to bring tomorrow near, but he must do the day's work.

The future is waiting with a sharp axe, and there will be heavy losses in the endless revolution that carries us on, willy-nilly, in the march of "progress." But the wise engineer need never be at a loss to know what the changes will be for the signs are everywhere; the question is how soon must he conform to the new duties that new occasions teach? How soon will it be economically possible to anticipate necessity? The engineer's task is to balance visions with today's practice.

* * * *

Federal Regulation of Holding Companies?

CONGRESS should regulate the interstate operations of holding companies, in the opinion of O. C. Merrill, given elsewhere in this issue. He advocates this action at once to prevent abuses that might call forth such drastic remedies as to injure the entire holding-company movement.

Many will take issue with Mr. Merrill as to the remedy to apply to possible holding-company abuses, but there is little experience to serve as a guide. Opinions differ because of the complexity of the subject and because of a limited experience with and knowledge of holding-company operations and possibilities. There is no good definition which will embrace the many varieties of holding or investment companies in the utility industry. Many are no more than financial groups seeking diversity in investments. At the other extreme are the direct ownership and management of utility properties. The general trend of a true holding company is toward a small headquarters organization composed of experts in the utility business who can be called upon as consultants by self-contained, subsidiary, operating utility properties—experts whose major duties are concerned with general policies in finance and management.

No one can dispute the advantages accruing to the industry and to the public through organized holding companies, but a fair-minded consideration of the growth of the movement shows that there is opportunity for abuses and bad practices at present, although the utility holding companies have had singularly clean records. But federal regulation contemplates a step far more drastic than is called for by actual conditions, and one certain to lead to bad consequences. Political decisions and influences, inexperienced regulators, disputes between state and federal regulatory bodies, adjustments of jurisdiction on financial aspects of the business, the handling of construction and management companies and a host of other factors can be counted upon to impart to federal regulation a degree of complexity and difficulty little anticipated by its proponents.

State regulatory bodies can control operations and charges paid utility holding companies, and the broader aspects of holding-company finance seem to lie within the control of state and national banking and investment laws. Stock exchanges and banks are themselves giving more and more scrutiny to securities and to the business interests that use their facilities, and laws adequate to the control of bad practices in finance already exist in most states. Observation of trends in industry leads to the belief that federal regulation is not necessary now and will not be necessary in the future.

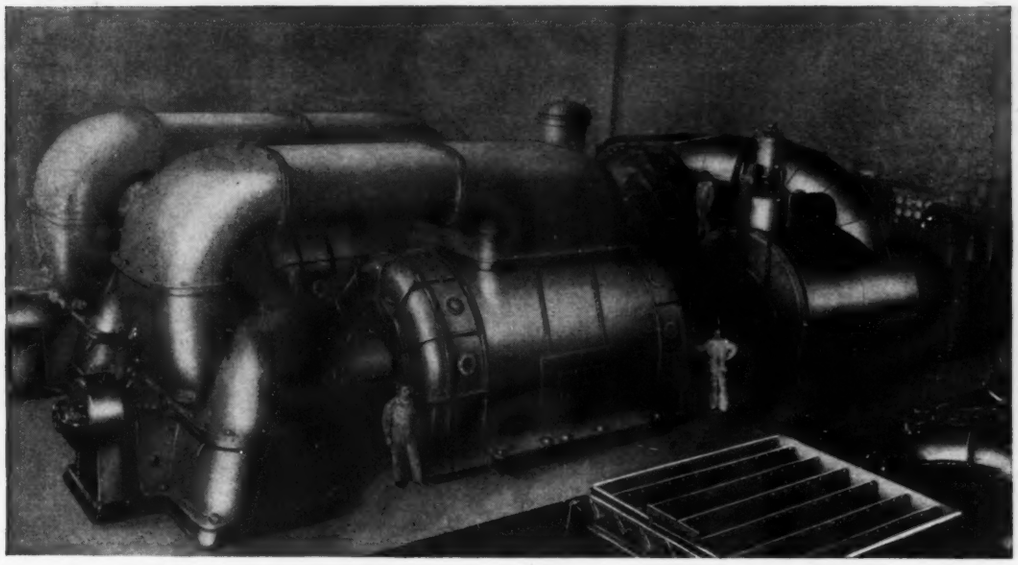
Aërial view of North Fork of Lewis River

Lewis River Hydro-Electric Development

MANY economical hydro-electric sites still remain on streams of the Pacific Northwest, such as those on the Lewis River in southwestern Washington. The north fork of the Lewis River is fed from the glaciers of Mount St. Helens and, together with its tributaries, is capable of an ultimate development of approximately 500,000 hp. Preliminary plans of the Northwestern Electric Company call for an initial development of 30,000 kw. and an ultimate of 120,000 kw. at the point on the river shown. Aërial photographs proved invaluable in reconnoissance work in this heavily timbered and mountainous country.

Mount St. Helens

Illustrations courtesy of Brock & Weymouth



160,000-kw. American Brown Boveri steam turbo-generator at the Hell Gate station of the United Electric Light & Power Company

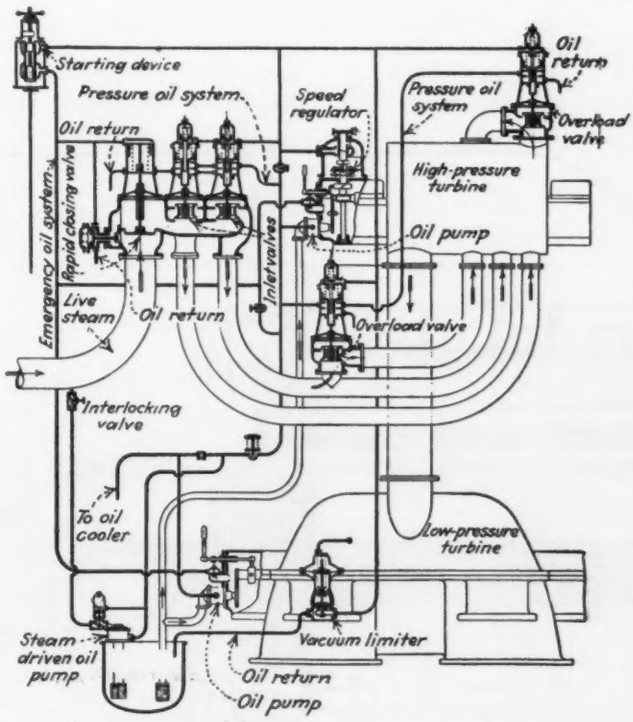
Features of 160,000-Kw. Hell Gate Turbine

Installed in 38x76-ft. space. Compact ventilating system. Water rate at various loads. How uniformity of temperature is secured. Steam admission control

THE 160,000-kw. steam turbo-alternator which has recently been placed in operation, as No. 8 unit, at the Hell Gate station of the United Electric Light & Power Company, New York, presents some interesting features of design and operation aside from those due to its size. The capacity of the unit, as large as any in the country, of itself necessitated technical pioneering, but the construction and operating conditions gave rise to further problems.

Less Space per Kilowatt

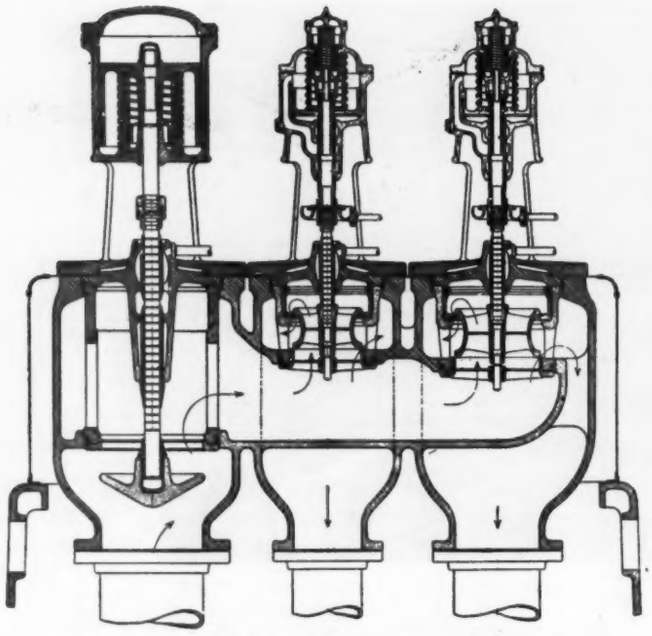
Probably the fundamental problem in the design of the American Brown Boveri machine was that of space. The Hell Gate station had only limited floor and subfloor space available, a condition which seems to be increasingly prevalent in metropolitan stations. The United company's initial request for bids called for the highest capacity unit which could be installed in the space, 38x76 ft., laid out originally for a 30,000-kw. unit. These figures are, incidentally, an excellent index to the striking development in the design of compact, high-capacity generating units. This is also interestingly reflected in the weight of the new machine; in 1903 a 5,000-kw. Brown Boveri steam turbo-generator weighed 160 tons, or 32 tons per 1,000 kw., whereas the new 160,000-kw. unit weighs 1,405 tons, or less than 8.8 tons per 1,000 kw.



Control gear for 160,000-kw. turbine

The need for a condenser affording 130,000 sq.ft. of condensing surface and utilizing 13,000,000 gal. of water per hour complicated still further the already crowded subfloor conditions. Provision had also to be made for an intake main with a capacity of 1,710,000 lb. of steam per hour, used by the turbines at maximum load.

The result of these conditions was the necessity of modifying the ventilating system for the alternators. A closed circuit including a fan and cooler is used for each generator which is direct-coupled to the fan. The air enters each alter-



Section through the valve chest with main stop valve and regulating mechanism

nator from below and passes out at the top through a huge overhead duct leading to the fan. The air returns to the base of the alternator through the cooler. This arrangement not only conserves space but is said to increase the reliability of ventilation and enables the fans to supply the comparatively large volumes of air at relatively high speed. This design also reduces the volume of cooling air to a minimum, about 127,000 to 137,000 cu.ft. being used per minute per alternator.

10.7 Lb. Steam per Kilowatt-Hour

The specifications required that the new unit use steam under the same initial conditions as the exisiting turbines, namely, 265 lb. and 20 deg. F. superheat. Both the temperature and pressure are considerably lower than the values utilized in the latest and more advanced designs of other Brown Boveri turbines, but the Hell Gate machine increases the range of extraction by finally exhausting at 1 in. of mercury, absolute. The high-pressure cylinder exhausts into the low-pressure element at about 19.2 lb. per square inch, gage, at maximum load. The turbines are arranged for two-stage bleeding, one at the exhaust from the high-pressure cylinder and the second after the fourth low-pressure stage. The high-pressure turbine is capable of utilizing steam at a maximum inlet pressure of 750 deg. F.

At maximum load 1,710,000 lb. of steam per hour will be used by the turbine, when running without bleeding, corresponding to 215,000 gal. of boiler feed water per hour. Under these conditions the steam consumption guarantees are as follows (including the energy required for ventilating fan motors):

Kilowatt output at terminals	160,000	90,000	55,000	130,000
Power factor	85	80	80	80
Steam consumption (bleeding) lb. per kilowatt-hour	11.60	10.35	10.46	10.93
Steam consumption (without bleeding)	10.70	9.80	10.00	10.20

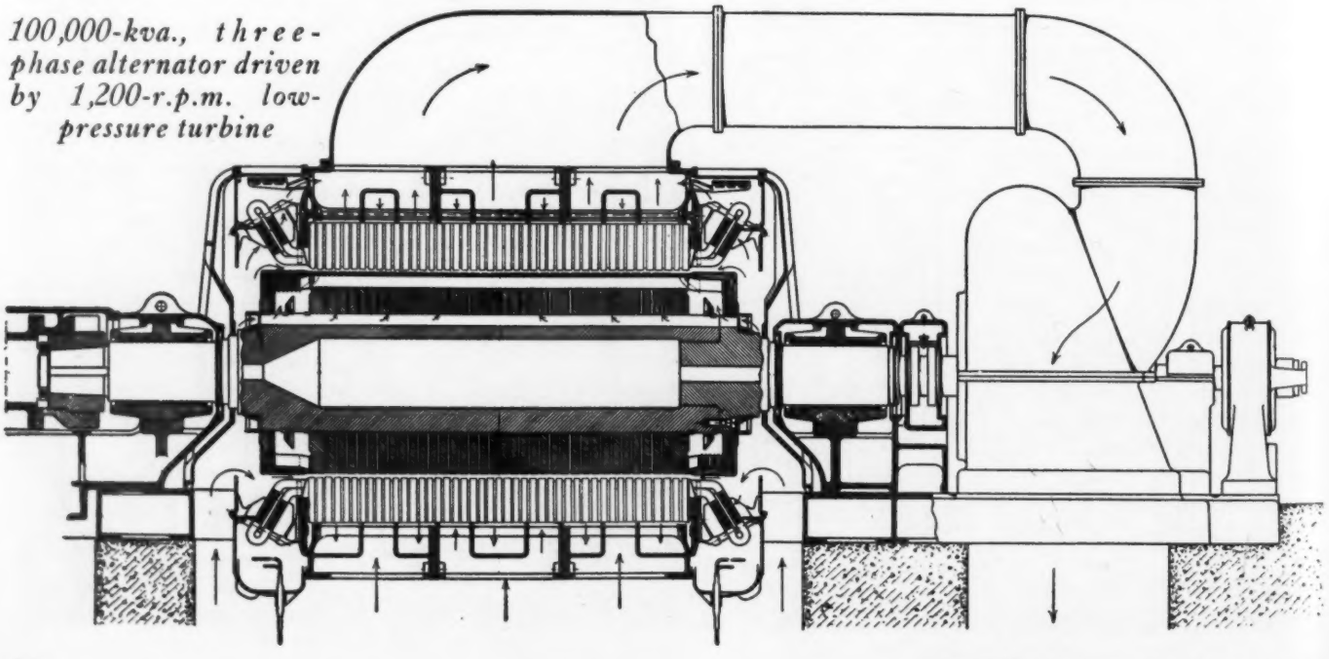
When the unit is operating at 90,000 kw., with feed water heating, the heat consumption of the whole machine is 11,660 B.t.u. per kilowatt-hour, corresponding to a thermal efficiency of 29.25 per cent from the steam at the main stop valve to the switchboard.

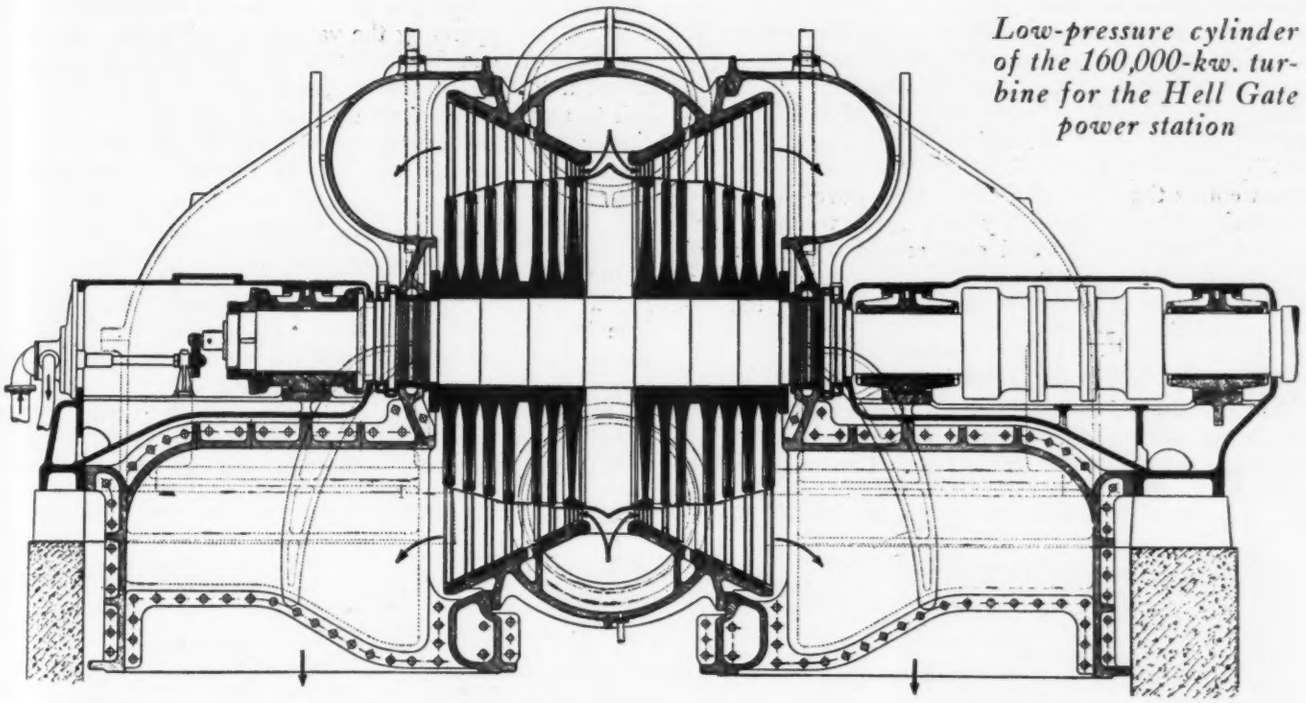
Shaft Construction That Avoids Warping

Smooth rotation of the large and intricate masses of the rotors presented problems which have been solved by new design, as well as by extension of the standard American Brown Boveri practice. The high-pressure spindle is built up of four short drums keyed to the shaft (a sliding fit), each held in place by two patented elastic rings. The low-pressure spindle is also built up, consisting of fourteen disks similarly keyed to the shaft.

An unusual design and a novel method of construction was used in the low-pressure shaft. A shaft of such large diameter would naturally have had a large mass with relatively small surface, while the disks have a large surface with relatively little mass. In warming up there would naturally have been a time differential in the expansion of the two elements, and as the disks are mounted on the Brown Boveri elastic rings, this differ-

100,000-kva., three-phase alternator driven by 1,200-r.p.m. low-pressure turbine





Low-pressure cylinder of the 160,000-kw. turbine for the Hell Gate power station

ential might have resulted in rough running and necessitated a long starting period. For this reason the shaft was made hollow, so that it could heat up more quickly. Because of the importance of metallurgical soundness to proper operation, an interesting method was used in forging this shaft, which is 26 ft. long, 36¼ in. in diameter, weighs over 25 tons, without disks, and is bored out to a diameter of 15¾ in. at the center and 7⅞ in. at the ends. During manufacture it was partially bored out to the larger diameter. Then a metallurgist crawled into the opening and inspected practically the entire interior for flaws, and only after this was done was that end reheated and forged down to its final dimensions.

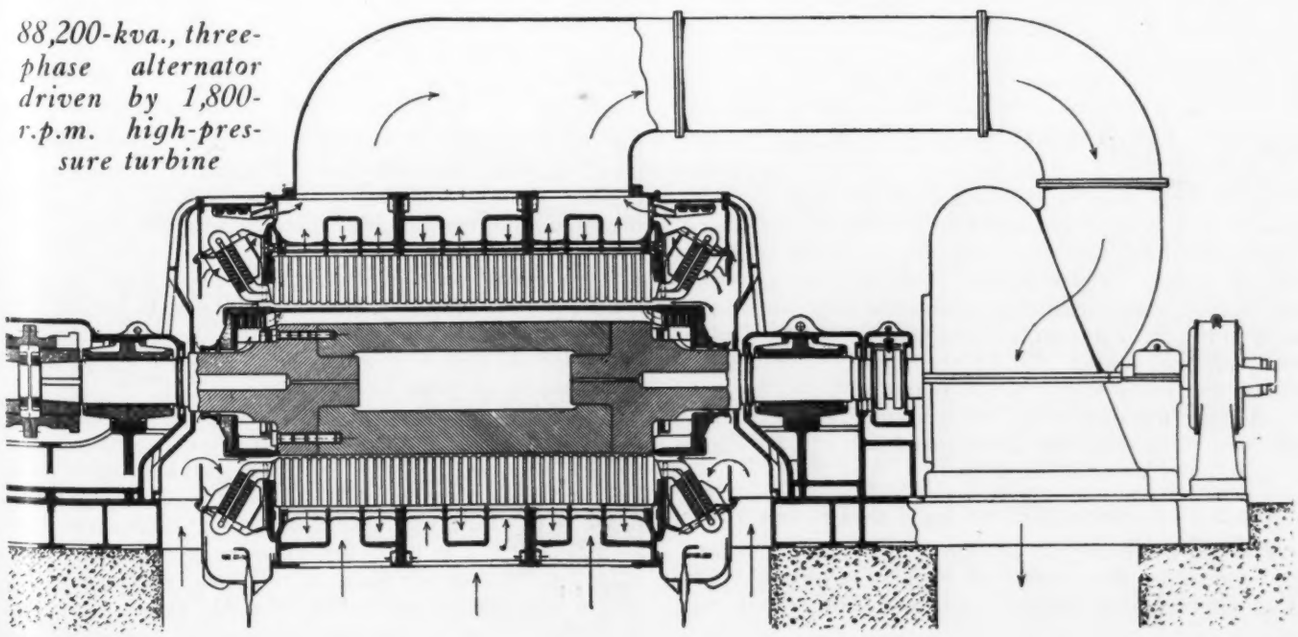
Precautions to Avoid Vibration

In the high-pressure turbine the blades have been sharpened to knife edge. In the low-pressure element, in which the clearances are large, leakage losses have been ingeniously overcome by directing the flow so that the steam bridges the gaps between the rows of blades.

Each rotating part has been subjected to a severe overspeed test and each one of the 18,000 blades has been tested, individually, for strength. Each disk, drum and balance piston has been balanced statically, and the completed spindles were balanced both statically and dynamically. The blading and disks were given a very searching vibration test. To prevent distortion due to internal stresses in the material, all cast-steel parts were "dead annealed."

Remote Control of Steam Valves

Operation of the unit is practically as easy as that of a 1,600-kw. machine; being entirely controlled from the operating station through remote control, no special at-



88,200-kva., three-phase alternator driven by 1,800-r.p.m. high-pressure turbine

tendance will be required. The whole operation is regulated hydraulically by oil pressure, which is controlled by a spring-loaded centrifugal governor driven by the high-pressure turbine spindle. Steam is admitted to the steam chest through two hydraulically operated main stop valves, each of which is furnished with a by-pass valve, also hydraulically operated. From the main valves the steam enters the turbine through seven governor valves, two primary, two secondary and three tertiary, each opened by oil pressure and each controlled by a small pilot valve. In starting and shutting down the unit a small controller is used for opening and closing the by-pass and main stop valves.

Control of Steam Admission at Different Loads

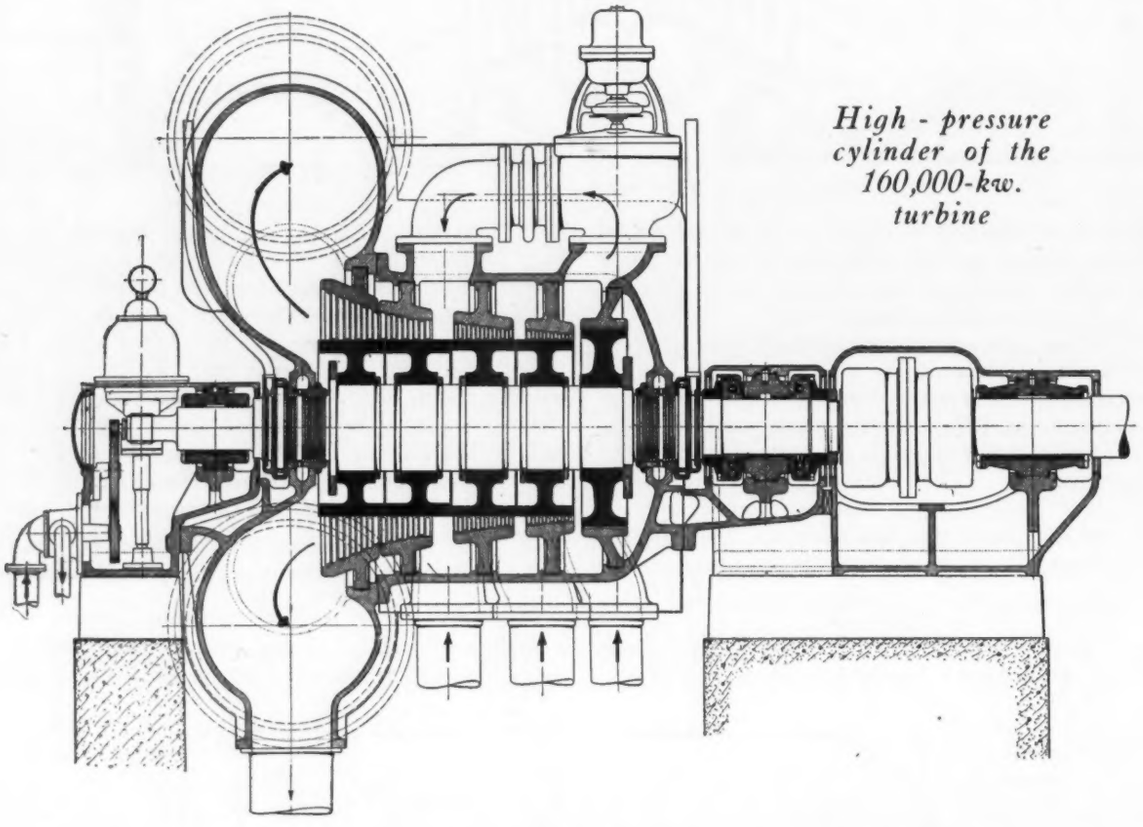
The primary valves take the unit up to a load of 50,000 kw; up to 90,000 kw., both the primary and secondary valves are opened and at 160,000 kw. all seven valves are opened. At 50,000 kw. steam is admitted only in front of the first section of the high-pressure turbine; above this, the first section, consisting of six stages, is by-passed, and is almost completely cut out at 90,000 kw. Above this load, the second section, of seven stages, is also by-passed. At 160,000 kw. both the first and second sections are almost entirely cut out, the total work being done in the third section, of nine stages. At the highest total terminal output that of the high-pressure unit is 73,000 kw. and that of the low-pressure 87,000 kw. As a result of the design the efficiency curve is extremely flat, with high efficiency at normal loads and an exceptionally large overload capacity.

Steam Reserve Pump for Bearing Oil

The oil system consists of four components: Lubricating, control, high pressure oil supply, governing. The two main oil pumps, supplied from an 8,000-gal. reservoir, furnish nearly 600 gal. per minute for lubricating the bearings and operating the valve gear. The bearing oil supply is safeguarded by a steam-driven auxiliary pump, which automatically starts should the two main pumps fail to supply the required pressure. There is, in addition, a separate emergency oil supply, in continuous service, which can be connected at any time by opening a single valve.

Facilities for Ventilation

In the generators, in addition to the closed circuit cooling arrangement, other important features are embodied. The housing and laminations are so constructed that the air passes radially through the stator iron through a large number of parallel ducts and also over the surface of the rotor. The end connections of the stator and rotor windings are cooled by air taken in by ducts at the ends of the alternators. Short bar-windings are used in the stator, two bars of the patented Brown Boveri design being inserted in each slot. Without restricting the cooling, the end connections are so secured as to give maximum mechanical protection against the results of short circuits.



High - pressure cylinder of the 160,000-kw. turbine

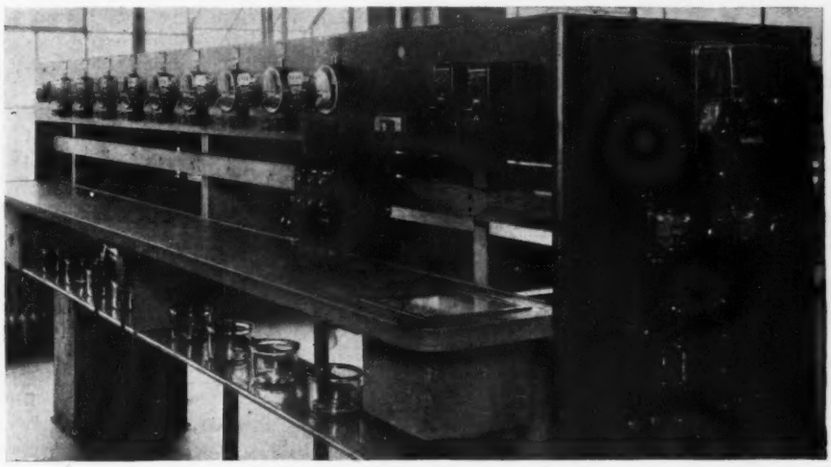
As a result of this design the temperature of the stators is guaranteed not to exceed 100 deg. C. and of the rotors 125 deg. C. (inlet temperatures of cooling air not exceeding 40 deg. C.) when the unit is being operated continuously at rated load.

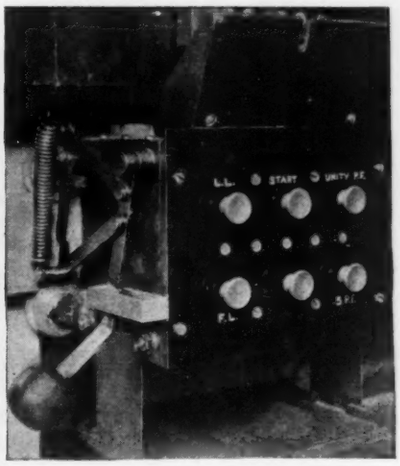
The voltage may be regulated between 13,200 and 14,500 volts from no load to the rated output. The normal voltage is 13,800. Other specified characteristics are: High-pressure generator, 1,800 r.p.m., 3,700 amp. per phase at full load, reactance about 16 per cent, excitation at 300 volts, 270 kw.; low-pressure generator, 1,200 r.p.m., 4,200 amp. per phase at full load, reactance about 14 per cent, excitation at 300 volts, 310 kw.

Shop Meter Testing Improved by Semi-Automatic Bench

By Albert J. Allen
Superintendent of the Meter and Test Department, United Electric Light & Power Company, New York

THERE are two general methods employed for shop testing of watt-hour meters. In one, the gang test, a number of meters are connected to the test circuit at the same time and operated together; in the other, the individual test, but one watt-hour meter is connected to the test circuit at a time. The gang test makes for speed in production; the individual test, while slower, is believed to have a higher degree of accuracy. With the idea of incorporating the best features of both methods and retaining the individual test, a new type of test board with several new features was constructed. The boards are dead front, all test connections are made automatically and loads and tests are controlled by push buttons.





Push-button operation and safety are features of meter test board

Duplex construction, with two operating sides and a control panel at each end, has been used. One side with its control panel is illustrated in the accompanying figure. The supporting columns house load resistances and loading transformers. This view shows nine meters on the board, with the contact mechanism in position to test the first one. The contact mechanism is mounted on wheels on the flat steel track directly in back of it and it picks up the live circuits from the rear of the panel when it is in a closed position. With this arrangement the tester moves the contact device from one meter to another back and forth along the test board.

The test operation is rapid and continuous and it is necessary for the tester to stand at his work. When the contact device is moved to the next meter the tested meter is unobstructed and may be removed immediately and a meter to be tested put in its place. A lever, shown on the left of the contact device, opens and closes the latter and also locks the device in correct position in front of each meter. A locking bolt engages a hole in the track and the contacts can be closed only when the device is properly located. The small panel is equipped with push buttons which control light and full loads at either unity or 0.5 power factor. A button is also provided to start the test. The small shelf below the contact device is for small meter parts and tools.

Each test board is provided with two standard meters, one of the conventional type, which is located in the bench top; the other standard is on the upper part of the end panel and functions to open the potential circuit of the meter under test when a definite number of revolutions have been made. This arrangement provides a cross check between two standards for every eighteen meters tested, thereby preventing incorrectly calibrated meters from getting on the customer's premises due to an error in a standard, as has happened where only a single standard was used and checked once or twice a week. To check one standard against the other, the contact device is moved to a position to the right of the last meter, where a stationary terminal block is mounted. In this position the standard in the bench top is connected to the standard on the control panel and is checked in the same manner as a meter would be tested. If any difference is found the standards are checked and the one in error calibrated. Both standards are regularly checked against indicating standards every two weeks. In addition to the feature of cross check two standards are required, as two methods of test are employed. One is for the majority of meters which are found within the accuracy limits of 3 per cent plus or minus: here the standard controlling the meter potential circuit is used and the semi-automatic features of control employed to obtain speed in testing. The second method of tests used for meters beyond 3 per cent plus or minus is the regular individual test whereby the meter under test is compared with the standard test meter in the bench top. The change from the first to the second method is accomplished by the insertion of a test plug which provides an extension cord and potential switch to start and stop the test. Inserting the test plug automatically disconnects the other standard, but retains the push-button control of loads. The tester concentrates his attention on the meter, as he is not required to move about the test board to change connections or operate switches.

In the first method of test the tester attaches to the meter a scale which is located near the disk. He then moves the disk test mark to the center scale position. The designated push buttons for test loads and power factor conditions desired are closed. Observing the meter disk test mark he pushes the start test button. The meter will then make a definite number of revolutions and stop; if it is 100 per cent it will stop at the same point from which it started. If the mark stops to the right or left of the scale center the meter accuracy is

determined directly from the scale. If the test mark is beyond the scale limits the second method is brought into action and the meter accuracy determined by comparison with a standard test meter.

The standard for controlling the meter potential circuit operates continuously at full load and its potential circuit contact goes into operation instantly regardless of the position of its disk, thereby eliminating any delay in starting a test. The standard is a 1-amp. secondary meter compensated for temperature at unity and 0.5 power factor and current transformers are used for different test loads. The two relays located below the standard on the control panel are of a double contact polarized type and operate from a 110-volt direct-current circuit. One is for opening and closing the meter potential circuit and is controlled by the standard; the other transfers the potential circuit from unity to 0.5 power factor and is controlled by the push buttons on the contact device. When the contact device is in contact with a meter a ground test may be made by pushing two buttons at the extreme left of the main meter panel; a ground on either the potential or current circuit of the meter is indicated by means of a lamp.

The test boards were designed to accommodate Westinghouse and Sangamo single-phase meters. In changing from one type to another it is only necessary to change the contact flap on top of the contact device and to relocate the supporting stud for holding the meter. Each board is provided with dry compressed air for cleaning meters. With this type of board the approximate number of new meters tested per day has been 60, and for old meters 45.

Decibel—The New Transmission Unit

By W. H. Martin
American Telephone & Telegraph Company

In 1923 the "mile of standard cable" was replaced in the Bell System by a new unit for expressing telephone transmission efficiencies and levels. At that time the generic term "transmission unit" was taken to designate this new unit, since it was considered desirable to defer the adoption of a more distinctive name until this unit had been given further consideration by others who would have use for a unit of this type. This new unit is defined by the statement that two amounts of power differ by one transmission unit when they are in the ratio of 10^1, and any two amounts of power differ by N transmission units when they are in the ratio of $10^{N(.1)}$. In accordance with this, the number of transmission units corresponding to the ratio of any two powers is ten times the common logarithm of that ratio.

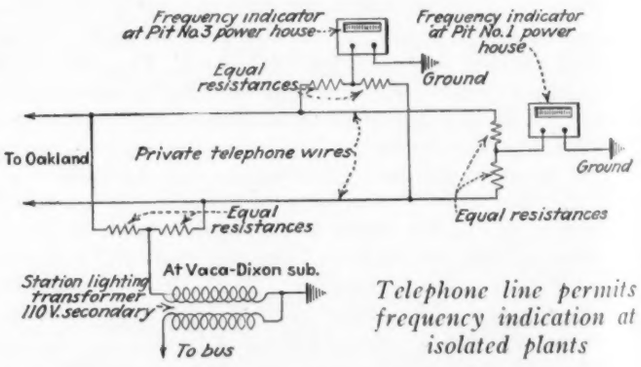
At the request of the international advisory committee, representatives of the Bell System attended some of its meetings at which this matter was discussed. In this joint consideration there arose the suggestion that the fundamental unit on the decimal basis be defined to be equal in magnitude to that of ten transmission units, so that the basic power ratio would be 10^1. The units proposed thus came to one based on the power ratio of 10^1 and the other on the power ratio of e^2, with the provision that decimal submultiples of either unit could be employed, using the customary prefixes to give the proper indication. On this basis, the numbers of the two kinds of units corresponding to a given power ratio differ by about 15 per cent. It was further suggested that the naperian unit be called the "neper" and that the fundamental decimal unit be called the "bel," these names being derived respectively from the names of Napier, the inventor of natural logarithms, and Alexander Graham Bell.

System Frequency Indication Via Telephone Line

By I. W. Collins
Assistant Load Dispatcher
Pacific Gas & Electric Company, San Francisco, Calif.

In the operation of a large transmission system it sometimes occurs that large and important generating plants situated at a distance from the load center become separated from the main network through relay operation at the terminal station. In such cases it is vitally important that these plants be reconnected to the system without delay in order that normal frequency and voltage conditions may be quickly restored. To accomplish this the operators at the plants thus isolated must be advised of the system frequency in order that they may meet it and facilitate synchronizing by the terminal substation operator. Transmitting this advice verbally over telephone or carrier current radio is at best a slow and inaccurate process, and in endeavoring to speed up operation under these conditions there has recently been developed a method by which system frequency indication is constantly available to the operators in such generating plants.

The accompanying diagram shows the apparatus and connections used by the Pacific Gas & Electric Company in transmitting system frequency indication from its Vaca-Dixon substation to the Pit River generating plants, a distance of more than 200 miles. The 110-volt supply at the transmitting end is taken from the ungrounded side of the station lighting transformer and is connected to the private telephone line wires through two equal resistances. The value of these resistances will vary with



Telephone line permits frequency indication at isolated plants

the length and conductivity of the telephone line, but they must be equal or the resulting unbalance will interfere with the use of the telephone. If incandescent lamps are used as resistances, they will also act as a reliable ground detector for the telephone line.

At the receiving stations standard vibrating reed frequency indicators are connected between the telephone line and ground as shown, 1,250-ohm telephone ringer coils being used as balancing resistances in the Pit River installations. This simple device has proved itself to be of inestimable value in the operation of the Pacific Gas & Electric Company's 220-kv. system and will no doubt be of interest to all operating companies that are faced with similar problems.

Shall We Regulate

The Holding Companies?*

Question of whether or not their activities constitute interstate commerce may soon be decided by the courts

By O. C. MERRILL
Executive Secretary Federal Power Commission

O. C. Merrill

WHEN we come to the proposition of regulating the holding company, which is at present the outstanding factor in the electric power industry, we have no experience to serve as a guide. These companies have not yet been subject to any regulation, state or federal, and the question arises whether their operations are of such a character that they can be said to be "affected with the public interest," and whether their activities as managers of operating companies in different states and their issuance of and trading in securities constitute interstate commerce?

The answer which is frequently made, that these also are matters of no consequence, that the public as a user of power deals only with the operating company, and that, since the rates and services of the operating company are regulated, the consumer, as such, is not interested in or affected by what the holding company may do, is by no means convincing. If it were to be held that the charges which a holding company may impose upon a subsidiary operating company, and which may add materially to its capital investment or its operating costs, are solely the concern of the contracting parties; that the control which the holding company through stock ownership may impose upon the policies and management of the operating company is subject to no public supervision or restraint; that holding companies may acquire the stocks of operating companies and may pledge such stocks as collateral for security issues of their own and may repeat and pyramid the process, regardless of the effect upon the credit of the operating company and without being answerable therefor to any public authority, it is apparent that an important and controlling element in the electric power industry would have escaped public regulation, and that investors in their securities would be left to the mercy of speculators, with no protection save such as might be afforded by "blue sky" laws.

BECOMES A MATTER OF PUBLIC CONCERN

The primary object of this rapid growth of the holding company movement is, of course, profits for these companies. To this, within reasonable limits, there is no valid objection. Profit is the motive for all business undertakings, but when the undertaking is a public utility, or affects a public utility, then the means by which the profits are acquired, the extent of such profits and the distribution of the gains of improved operations become a matter of public concern. If the pyramiding of securities so as to concentrate all the profits of a group of companies for the benefit of a limited investment at the top, thus creating a speculative financial structure safe only in fair weather, may jeopardize not only the credit of the operating company but the interests of security holders, such action also becomes a matter of public concern.

No reliance can be placed on competition as a corrective of abuses. Holding companies may compete actively for acquisition of new properties, just as do operating companies for extensions of service into new territory, but competition for new territory is subject to regulation, while acquisition of new properties generally is not, and the very fact of the keenness of the competition, forcing the payment of excessive prices for the new properties, is adverse to the public interest, for these excessive prices are bound to be reflected in the rate base and in the prices which the consumer must pay.

Were these activities confined to the limits of a single state they could, with little doubt, be brought under the regulatory control of the state, but they are not so confined. It may be that where the operating companies are wholly intrastate the state can control the character of the service or management contracts and the charges made thereunder. But even here, unless the holding company is likewise a corporation of the same state, no means would be available for compelling the presentation of evidence upon which to determine the reasonableness of the contract terms. Presumably, also, the state in which the holding company is incorporated could control the issuance of its securities through its grant of charter rights, if not otherwise, but holding companies, like other corporations, are prone to incorporate in states with lax corporation laws, and we have been regaled with the spectacle in recent years of states bidding for this business by outdoing each other in the lack of restraint which they place upon the corporations which they create. At the best, and leaving to the states all that they have jurisdiction to handle, the greater part of the activities of holding companies are beyond the legal reach of the individual states.

**From an address on "The Administrative Problems of Superpower" delivered at Yale University, March 20.*

We must then ask, do these activities constitute interstate commerce within the meaning of the commerce clause of the Constitution? The question appears not yet to have been directly answered by the courts with respect to electric power holding companies, although it soon may be in the case now pending between the Federal Trade Commission and officials of the Electric Bond & Share Company. Similar situations have, however, been the subject of decisions of the courts.

The operations of the holding companies through their service and management contracts involve continuous intercourse between these companies and their subsidiaries in different states—the giving of information, the transmission of reports, the purchase, shipment and exchange of equipment and supplies—all in interstate commerce. They involve also the maintenance of accounts, the deposit of moneys, the payment of dividends, the sale and exchange of securities for corporations in different states, all of which in other connections have been held to be interstate commerce. Moreover, many of the operating companies, subject to the control or management of the holding companies, are themselves engaged in interstate commerce. The holding companies through their service and management contracts are a means by which this interstate business of the operating companies is carried on, and participation in the management and direction of interstate commerce constitutes, of itself, engaging in such commerce.

Does It Constitute Interstate Commerce?

The courts have held that the shipment and sales of stocks and bonds between the states constitute interstate commerce,† and companies holding the stock of other corporations engaged in interstate commerce have been held subject to dissolution or prosecution under the commerce clause.‡ Charges of the character made by the holding companies upon the operating companies manifestly may be of such amount as to place a burden upon interstate commerce, and it has been held that the power to regulate interstate commerce extends to every person, corporation, instrumentality, act or practice which may burden or restrain such commerce.

Under all the circumstances of the business which they carry on, it is hardly to be doubted that the holding companies are engaged in interstate commerce, and that they are, therefore, subject to regulation to such extent and by such agencies as Congress may direct. Congress has, however, taken no action toward regulating the interstate activities of the holding companies, and, except to the very limited degree provided by the federal water power act, none toward regulating the interstate energy deliveries of the operating companies. Both should be undertaken before the situation has developed to a point where the correction of evils that may have arisen might require such drastic remedies as seriously to injure the industry as a whole and to bring the entire holding company movement, regardless of its benefits, into disrepute.

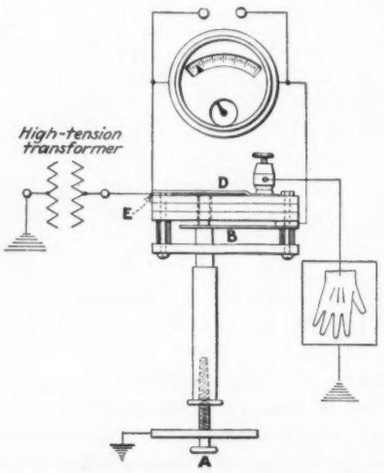
We have on our statute books laws of a different character than those we have been discussing. They are known as anti-trust laws. The Clayton act, for example, prohibits the acquisition by one corporation engaged in interstate commerce of the stock of another corporation also engaged in such commerce, or the acquisition by a holding company of the stock of two or more corporations engaged in interstate commerce, where the effect may be substantially to lessen competition between the corporations or to restrain trade in any section or community, or to tend to create a monopoly. It has been our national policy, however, as far as public service corporations are concerned, to proceed in another direction, to permit monopoly and to overlook restraint of trade, trusting to public regulation to give us the benefits of monopoly and to prevent its abuses. It is earnestly to be hoped that we may be able to apply to this new agency of the holding company the same principles of regulation which, when effectively exercised, have been for the benefit of both the public and the industry. If, however, this is not done, or cannot be done, we have this other remedy in reserve.

†*Alabama & N. O. Transportation Co., et al., vs. Doyle, 210 Fed. 173; Compton Co. vs. Allen, 216 Fed. 537.*
‡*U. S. vs. Northern Securities Co., 193 U. S.*

Safeguarding a Glove Test

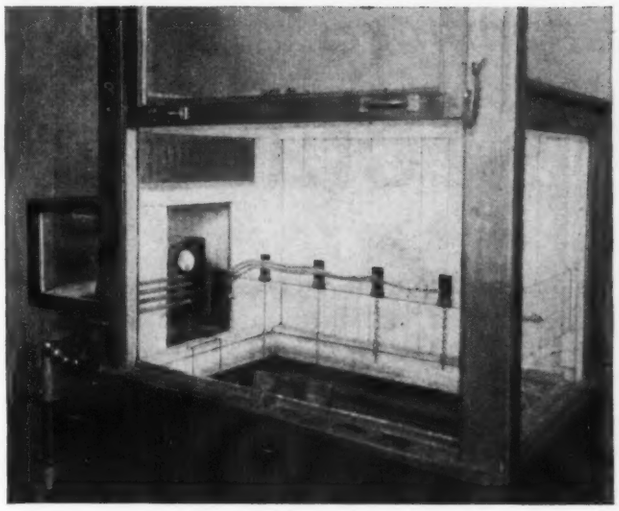
By H. C. Kenney and H. D. Pendleton
Connecticut Power Company, New London, Conn.

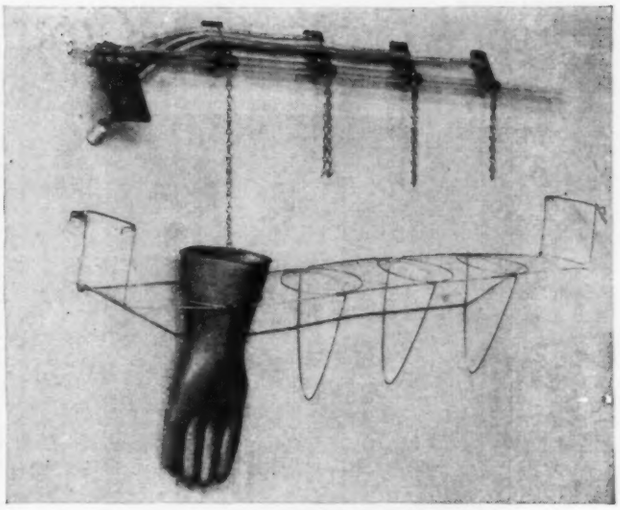
TO FACILITATE glove testing the meter department of the Connecticut Power Company has designed and built an installation in which speed of operation and safe application of high voltages have been given special attention. A standard high-voltage transformer and regulator are used and the wiring is arranged so that four gloves may be placed simultaneously in parallel across the high-tension terminals of the transformer. Milliampere readings may be obtained of the leakage through any glove by push buttons which throw any desired glove into the meter circuit. In testing, each glove is filled with water and placed on a light rack of No. 10 brass wire, the rack being readily placed in or withdrawn from the tank. The gloves are subjected to high voltage by the insertion of chains hung from terminals carried by a glass rod above the tank and provided with hooks to keep the chains out of the way when not in use. Each chain is fed from a high-tension binding post at the transformer by an individual high-voltage ignition cable. The glass rod can be readily removed in case other tests are desired with the apparatus by turning the rod slightly and lifting it out without disturbing any connections. When in use, the necessary contacts are made by pressure from a small weight shown in the close-up view of the rod and frame. Under normal conditions the gloves are in parallel across the transformer terminals, the pressing of any button giving a milliampere leakage reading on the corresponding glove. A spark gap is shunted around the meter to prevent injury in case a glove breaks down at the instant of pressing a button.



Push-button control puts milliammeter in series with glove

When a button, *A*, shown in the accompanying figure, is pressed a contact pin (which is riveted to the spring, *B*) is forced against *D*, completing the meter

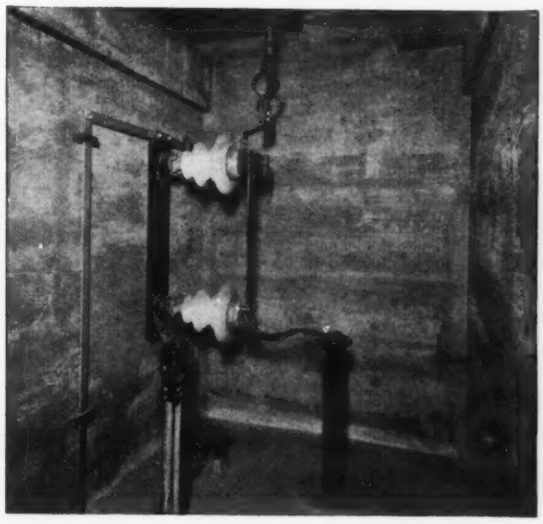




Glove-testing apparatus features safety through push-button control

circuit first. With a little more travel the circuit is opened at *DE*, thus putting the meter in series with a glove. The tension of the springs *B* and *D* reverses the process when pressure is removed from the button. The buttons, *A*, are of brass and are screwed into 12-in. micarta rods having locknut adjustments. The four buttons are supported by a grounded brass plate which insures the operator against shock. All high-tension terminals and leads are inclosed by glass and the transformer and regulator cannot be energized until the front sliding sash is closed and latched. This is accomplished by a set of contacts which are bridged by the closing of the protective sash.

66-Kv. Disconnect Installation Is Side-Opening



HERE is the manner in which the 66-kv. bus selector and oil circuit breaker disconnecting switches are installed in the new Washington Park substation of the Commonwealth Edison Company. The switches are ball bearing, remote operated and open sidewise. Full opening brings the blade into the fault bus clip, but the blade may be stopped in the clear position or 45 deg. opening.

Costs for Vitreous Enameling Cut with Electric Heat

ELECTRIC furnaces burn more enamel ware per unit of hearth area than combustion equipment, said A. D. Dauch, engineer George J. Hagan Company, at the recent New England industrial electric heating conference. This results in fewer furnaces, with less plant space for burning purposes and, in new plants, a saving in building costs. In one plant one 5-ft. x 11-ft. electric furnace is burning 12,000 sq.ft. of sheet per day compared with 8,000 sq.ft. from a 5-ft. x 11-ft. oil-fired furnace. Both are operating on the same class of ware and under the same conditions. The same number of man-hours is required in each case. Several years ago a Midwestern plant replaced six combustion furnaces with two electric furnaces and reduced labor costs $65 per day. Explosion and fire hazards are eliminated by the electric furnace, which also practically does away with maintenance as it has no hearth or muffle. A large plant in New York state has operated three 5-ft. x 10-ft. electric furnaces for more than five years with a total maintenance charge of less than $75, and an Ohio concern has not replaced a single item in its furnace since May, 1924.

Rejects or discounts from a properly designed electric furnace are rare. A prominent specialty manufacturer in Ohio reports burning more than 5,000,000 lb. of cast-iron ware without a single reject due to faulty burning. A Pennsylvania stove plant states that it has never lost a piece of sheet steel ware because of faulty burning. A Pennsylvania jobbing shop uses both combustion and electric furnaces for burning enameled ware. Frequently during the day it is necessary to shift from cast iron to sheet steel, or vice versa. With the combustion equipment an hour or two elapses before the furnace can be used for burning sheet steel. In the electric furnace the time interval is a matter of minutes. Also, in changing from ground to first or second cover coat or the reverse, there is no lost time. Several furnaces in operation are now burning from 22 to 28 heats per hour day after day, considerably exceeding the speed of the fuel-fired furnace. Tiering is easier to accomplish in the electric furnace, and one plant increased the rate of burning cast iron from 960 to 1,980 lb. per hour by the use of electric heating.

Executive Cites Advantages of

Metal-Clad

J. L. Hecht

Armored equipment offers improvements in safety to life, reliability of operation and reduction in design and construction costs as well as system flexibility

By J. L. HECHT

Vice-President Public Service Company of Northern Illinois, Chicago, Ill.

THE use of metal-clad switchgear in this country is comparatively recent. However, it has been used satisfactorily in England for many years. A little reflection will show that the use of this type of gear has come about through the normal requirements of necessity and demand as is shown by the forerunners of this kind of equipment, such as steel switchboards, truck type oil circuit breakers and steel switchhouses for outdoor service.

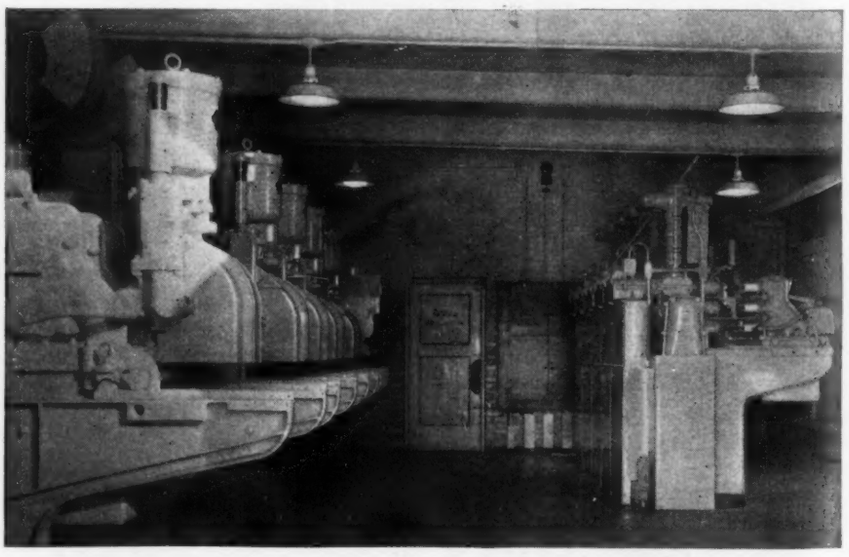
The outstanding reasons for the development of metal-clad switching equipment may be stated as safety and the demand for complete factory-built equipment. This latter feature carries with it the element of high salvage value when growth of system demands the replacement of switching equipment. If we enlarge upon these two fundamental reasons the multitude of desirable features that can be attributed to this class of equipment are easily pointed out.

Taken in the logical order of engineering, construction and operating, from the engineering standpoint the metal-clad gear offers a definite way out of that maze of details which the engineering departments of the operating companies are now required to go through on the ordinary type of switchgear. Metal-clad gear accomplishes for the electrical engineering field that which has long ago been perfected for the mechanical; that is, equipment completely factory built with the elimination of the detailed engineering by the operating company. The operating company is primarily in the business of the manufacture and sale of electrical energy and is not a design and engineering institution. However, reluctance on the part of the manufacturer sometimes forces this latter function upon the operating company.

Metal-clad equipment, because of its unit type, lends itself very well to the economical use of space and the question of space has become a very important element in the higher voltage equipment. Generating stations, the output of which is largely taken away at 132,000 volts or higher, require a greater amount of land for the high-tension switching equipment than that required for the development of the station itself. Metal-clad equipment for this class of service gives promise of effecting a considerable saving in space. Certain manufacturers have expressed a willingness to build 132,000-volt metal-clad switching equipment. This indicates that there is no limitation on metal-clad gear as to voltage requirements.

Installations are already in service in this country covering the usual standard voltages up to and including 33,000-volt outdoor equipment.

Metal-clad gear has solved the construction problems to a greater extent even than the problem of detailed engineering has been solved. It is now possible to obtain metal-clad equipment so that it may be installed with a minimum of field labor. Progress in this line has been very rapid. The completeness of factory assembly of this type of equipment at present seems to be limited only by the maximum size that it is possible to transport.



Reyrolle 2,300/4,000-volt indoor type gear in a distribution substation

Switchgear

As a pioneer and continuing user of metal-clad switchgear the Public Service Company of Northern Illinois is competent to form an unbiased estimate of the value of this type of equipment. On this system six such installations are already in operation and four more are under construction. Of those in operation, three are distribution substations supplying four to six 2,300/4,000-volt feeders each. The first distribution substation, which also includes metal-clad switching equipment for a 15,000-kva. synchronous condenser, has been in service since July, 1926. In a generating station is an installation for a 50,000-kw. unit, including 12,000, 4,000 and 440-volt buses and switches, which was put in service in June, 1927, and was described in ELECTRICAL WORLD *of September 17, 1927.*

An indoor substation of the armored type with seven 12,000-volt lines and three transformer banks has been in operation since September, 1927. An outdoor metal-clad substation with four 33,000-volt lines and two rotary converters—the first high-voltage outdoor substation of this kind in the country, probably in the world—and with switches of 750,000 kva. rupturing capacity has been in service since March, 1928, and was described in ELECTRICAL WORLD *of July 28, 1928.*

The installations under construction include one distribution substation of the type just mentioned, two 33,000-volt substations similar to the one above referred to and one switching equipment for a 15,000-kva., 12,000-volt synchronous condenser. Among the metal-clad installations here listed are both the compound-filled and oil-filled types.

An installation is being constructed at present in which each unit assembled in the factory will consist of all three phases of one main switch and one auxiliary switch, together with current and potential transformers for a complete 33,000-volt line bay, the complete unit weighing approximately 21 tons.

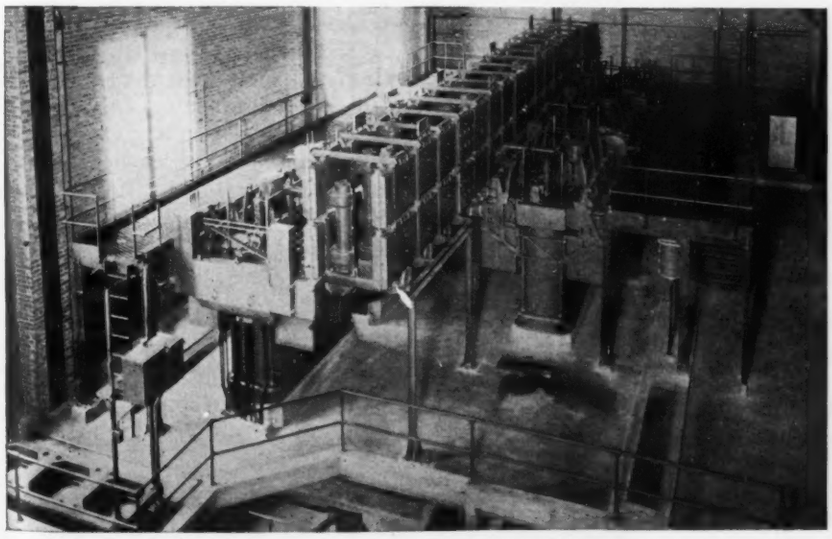
BACK TO THE IDEAL OF SIMPLICITY

The operating features of metal-clad switchgear are grouped largely around one of the fundamental development reasons—safety. Safety may be broken into two divisions—first, safety to human life; second, safety to the operation of the electrical system, which means equipment reliability.

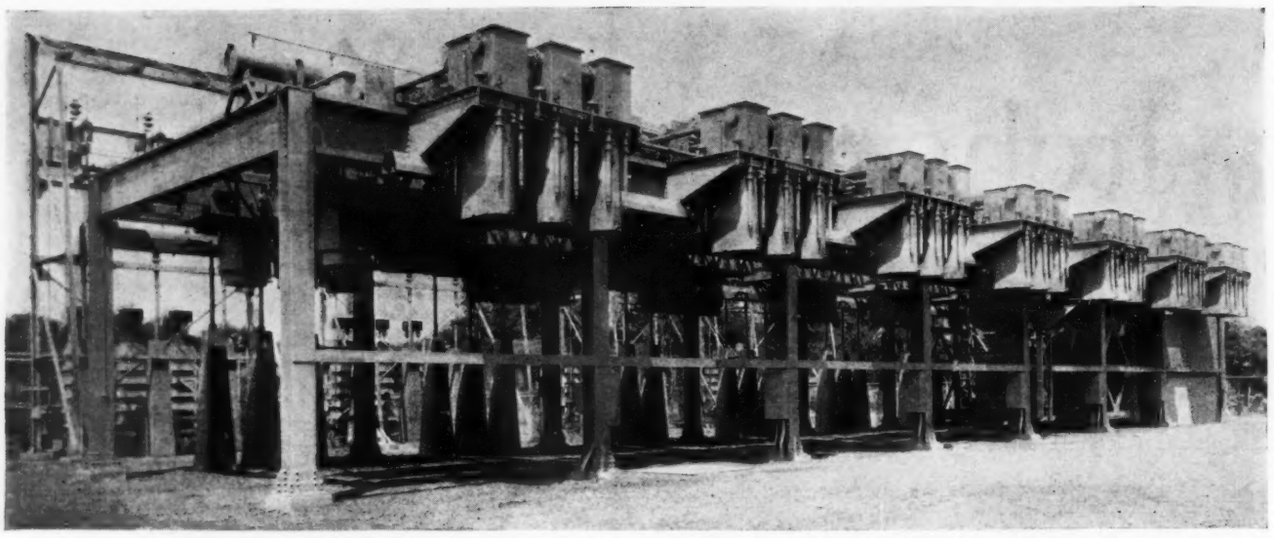
It may be proper to go into retrospection at this point and trace the development of the electrical industry with regard to the safety element. In the early days of the industry, when systems were small and simple, the switching structure and apparatus were also simple and easily within the comprehension of the average operator. As the industry grew, along with it grew the systems; the simple bus being supplemented by the transfer bus, the double bus, the test bus, the ground bus and all the other complexities, rapidly demanding their places in the scheme of development. The human mind, however, apparently has not been able to keep up with this rapid expansion, that has resulted in the very complex maze of switches, busbars, insulators, disconnects, wires, etc., which now form an integral part of every large system. It is certain that this increased complexity of apparatus and equipment has taken its toll in human life; the human mind has not been able to hold the component parts of this maze in proper relation during each minute of the day and each day of the year and there comes that momentary lapse which has been fatal in so many cases. The solution of this complexity is metal-clad gear, with its characteristic simplicity.

There is no question but what the metal-clad equipment brought about one of the greatest steps in this industry to insure safety to that priceless object, human life, through total inclosure of all live parts in grounded metal and the application of positive mechanical interlocks. In accomplishing this safety to human life the metal-clad gear coincidentally accomplishes safety to the electrical system from the operating point of view. The total inclosure of all live parts and the use of positive mechanical interlocks, together with the rugged and compact equipment, have reduced the possibility of break-down from causes common to the ordinary type of gear, and even in case of failure only a small area is affected and the minimum of equipment is out of service.

The metal-clad equipment, due to its features of safety and reliability, has also brought about simplicity in design. Admitting the advantages of flexibility of the conventional complex structures with their double bus, ground bus, etc., it must also be admitted that these complex structures, with their duplications of equipment, came about largely as the result of the lack of faith in the reliability of the single line of defense. Therefore, we can again say that the metal-clad gear may lead us back into simplicity of design, which, after all, is the ideal to attain.



Indoor type, 12,000-volt Reyrolle installation in Waukegan station



Outdoor type, oil-filled gear in 33,000-volt substation at Wheaton, Ill.

The actual operating performance of metal-clad installations in the Public Service Company of Northern Illinois has been very satisfactory. The operation under stress has been better than was expected. The maintenance and mechanical troubles, which cover the larger percentage of troubles with the conventional type of gear, have been practically eliminated with the metal-clad equipment.

The operating man, while always interested in improvements that will promise continuity of service and decrease the hazard to the human life, nevertheless must face the problem of cost. Here again the metal-clad equipment, with all its many other advantages, has remained within reach and on typical installations the total completed cost, including all the items, has been approximately the same as that of the ordinary type of equipment. The larger initial cost for the equipment has been compensated by the reduction in buildings and structures, in field labor, in engineering work and subsequent reduction in maintenance. There is every evidence that the total over-all cost will be in favor of the metal-clad equipment when our American production methods have been more freely applied to this type of equipment to reduce the manufacturing cost and also still further reduce the field labor and engineering cost.

While the operating company is always concerned with cost, such as first cost and operating and maintenance costs, there is one additional item which is of prime importance, and that is the serious problem constantly confronting us with regard to replacement of switchgear because of the increase in duty on the switches as the result of growth of load. The heavy expense entailed in such replacements on the conventional type of equipment is because of the need of rebuilding structures and the heavy write-off entailed due to the very low salvage value of the equipment replaced. In general, it is seldom that more than approximately 15 per cent salvage can be obtained for the open type of equipment replaced by an installation of larger capacity. The metal-clad switchgear offers the solution to the problem of heavy write-off. As it is outgrown the metal-clad gear can be removed and installed at points of lesser load density with a salvage value of probably 80 per cent to 90 per cent, requiring a comparatively small write-off. Furthermore, the need of structural changes can be practically eliminated by displaying a reasonable amount of foresight.

Increasing use of this type of equipment seems to be self-evident. The success of the present installed metal-clad equipment in substations and in generating stations of the Public Service Company of Northern Illinois definitely points out the faith which has been placed in it. A large field for future use which has practically been untouched is that of customers' substations. As a matter of fact, it was for this use that the gear was originally developed in England, limited space and safety being the reasons. The natural evolution of progress, which is always coupled up with the safeguarding of human life, perhaps most definitely assures its future use.

Power Costs Easily Overemphasized

"I HAVE been engaged in the manufacturing industry all my life and I know from experience that there are many things more important to the manufacturing industry than power. For instance, the easy accessibility and low cost of raw materials, the efficiency and cost of labor, the cost of transportation and very often the cost of local taxes is greater in importance than that of power. Therefore I think we are attaching entirely too much importance to the element of power in attracting industries to our state. I don't believe we will ever secure a single industry because and solely on account of cheap power. There are other more important considerations. We have paid the Bangor & Aroostook Railroad more for freight in the last 30 days than it costs to pay for power in our mill for ten years. That is not an exaggerated statement. I believe that in the development of the water powers of our state we are creating more taxable property."

—From a statement by FRANK HAMLIN,
Manager American Thread Company, Milo, Me.

Transmission System Planning*

Southeastern Power & Light Company serves 777 communities in five states. Factors underlying system growth. Planning modified by conditions of service

By W. E. MITCHELL and HOWARD DURYEA

Vice-President and General Manager Georgia Power Company and Chief Statistician Southeastern Engineering Company, Respectively

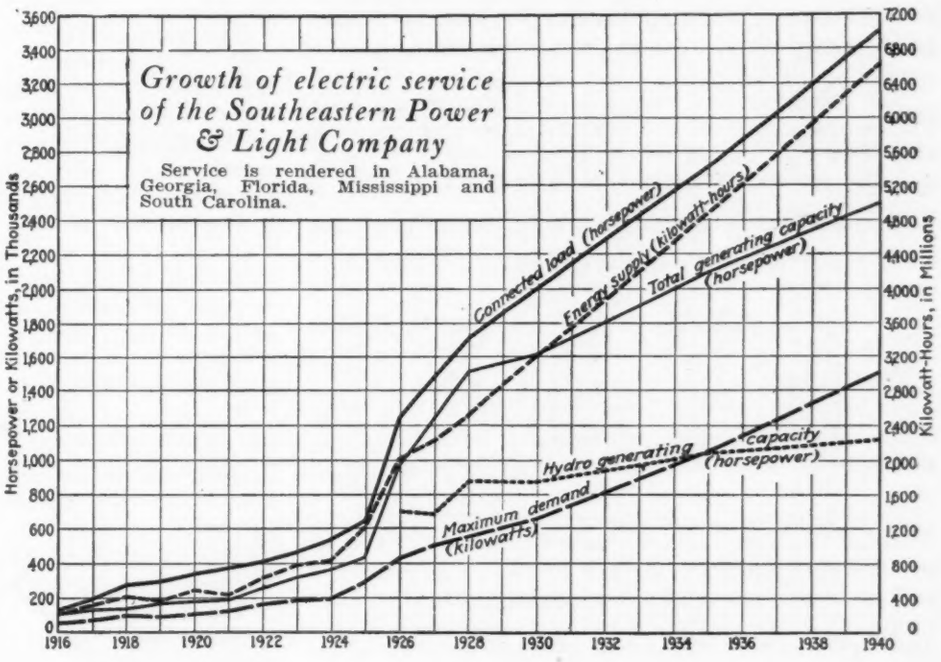
THE Southeastern Power & Light Company has been in existence slightly more than four years, yet its growth during that period, including acquisition of additional properties and expansion of existing companies in new territory, has resulted in net operating revenues in 1928 of more than four times the amount in 1924, a rate of 41 per cent compounded annually. This rate of growth is nearly three times as fast as that termed "rapid" by the American Telephone & Telegraph Company in forecasting its future. This growth may be better comprehended by reference to the accompanying tabulation showing energy supply, demand, generating capacity, etc.

The company's efforts have been devoted largely to rendering additional service in territory previously served and extending its lines into new territory, much of which has so far been rather lean. Hydro-electric development is expensive from a capital cost standpoint and this fact, combined with many extensions into territory where industries and commercial enterprises are widely scattered, has added to the cost. As a result securing necessary funds and their use has been a tremendous problem and has involved finance even more than engineering. Plans have, therefore, had to be carried to final conclusions largely by step-by-step, cut-and-try methods.

Considerable efforts have been necessary to render adequate service by building up organizations in the new territories and co-ordinating existing ones. In fact, many problems resulting from consolidation of comparatively large companies are more difficult to solve than those of newly organized ones.

There have been a number of problems whose solution depended largely on policy rather than any mathematical analysis. In so far as generating plants have been concerned, the existence of the Muscle Shoals situation in its continuously unsettled state has greatly influenced any program that might have been laid out. The problem of collecting meter readings and operating data over an area of 40,000 square miles (the area served by one company) is no small one.

Factors have been used in attempts to solve some of the problems, as, for instance, measurement of desirability of new customers or communities by the application of a three to one ratio of cost to serve to expected net annual operating revenue. Factors and charts have also been used to indicate probable return on investment in such cases. Charts and factors of growth of typical industries and territory have also been used. The rapid expansion of the company has rendered difficult any checks of actual results against these factors because of necessary changes in operating methods to take care of rapid expansion, with resulting consolidation of areas and changes in operating procedure.


Growth of electric service of the Southeastern Power & Light Company
Service is rendered in Alabama, Georgia, Florida, Mississippi and South Carolina.
Connected load (horsepower)
Energy supply (kilowatt-hours)
Total generating capacity (horsepower)
Hydro generating capacity (horsepower)
Maximum demand (kilowatts)
Horsepower or Kilowatts, in Thousands
Kilowatt-Hours, in Millions
0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000 2,200 2,400 2,600 2,800 3,000 3,200 3,400 3,600
0 400 800 1,200 1,600 2,000 2,400 2,800 3,200 3,600 4,000 4,400 4,800 5,200 5,600 6,000 6,400 6,800 7,200
1916 1918 1920 1922 1924 1926 1928 1930 1932 1934 1936 1938 1940

PROMOTION OF INDUSTRY ESSENTIAL

Estimates for growth of load in this territory for five, ten or fifteen years in the future are based largely on the promotion of industry and the expansion of commercial and agricultural activities and, like the question of policy, are not subject to close mathematical prediction. Past experience has shown that within a few years after the preparation of forecasts of system plans considerable portions of the load came from in-

*Based on presentation to power systems engineering committee, N.E.L.A., at recent Cleveland, Ohio, meeting.

dustries which were not in existence in the territory at the time the survey was made. In other words, the future growth of central-station electric service in this territory, which we believe to be one of the fastest growing areas in the United States, has of necessity depended largely on faith. This is the basis on which the individual companies now forming the Southeastern Power & Light Company were established. Nothing else could have attracted funds necessary to start and continue the companies under the early handicaps of cheap coal, undeveloped territory and lack of appreciation of its natural resources.

Another item of considerable uncertainty is the varying river flows, which, with a company securing 50 per cent or more of its energy from hydro-electric plants, has a great effect on operating expenses from year to year. While these flows may be predicted with some degree of accuracy over a considerable number of years, their prediction for a given year is practically impossible with the amount of data at hand. This subject is being studied continuously, but no real solution has yet resulted.

As a result of the foregoing conditions most of the Southeastern Power & Light Company's problems relating to system planning have been solved by a study of individual items, often in great detail, rather than by application of factors.

The Southeastern Power & Light Company is a holding company interested in electric, gas, transportation and related service in the states of Alabama, Georgia, Florida, Mississippi and South Carolina. Organized in 1924, it succeeded to the then existing interests of the Alabama Traction, Light & Power Company in Alabama and has since acquired interests in various other public utilities in the Southeast. The territory served extends from Charleston, S. C., on the east, to central Mississippi on the west, a distance of approximately 600 miles, and from the southern border of Tennessee on the north to the Gulf Coast on the south, approximately 350 miles. This area covers 241,722 square miles, with approximately 10,500,000 population. Included in this territory are the important cities of Atlanta, Macon, Augusta, Athens and Rome in Georgia; Birmingham, Anniston, Gadsden, Montgomery, Selma and Mobile in Alabama; Meridian, Hattiesburg, Laurel, Gulfport and Corinth in Mississippi; Pensacola, Fla., and Charleston, S. C.

Table I—Growth of Southeastern Power & Light System

Year	Net Operating Revenue, Dollars	Installed Generating Capacity, Kva.	Energy Supply, Kw.-Hr.	Maximum Demand, Kw.	Connected Load, Hp.
1924	9,810,829	354,965	823,247,290	189,050	526,562
1925	17,796,847	424,275	1,196,244,494	284,000	638,749
1926	37,359,569	964,780	1,969,183,662	419,280	1,238,122
1927	41,669,252	986,953	2,215,946,923	475,000	1,353,796
1928	44,262,957	1,189,000	2,369,000,000	525,000	1,820,328

Communities served are progressive, represent a wide diversity of industrial, agricultural and commercial activities and include three well-known ocean shipping points, Mobile, Ala., on the Gulf Coast, Charleston, S. C., and Brunswick, Ga., on the Atlantic Coast.

The individual communities served by the several operating companies have a total population in excess of 4,035,000, total connected load of the electric service companies approximates 1,820,000 hp. and 281,000 electric and 75,000 gas customers are served.

The Southeastern Power & Light Company differs from many large holding companies in that practically all of its properties are interconnected by electric transmission lines so that energy may be interchanged between all of the companies and between nearly all of the cities served.

Table II—Energy Interchange Between the Two Largest Southeastern Power & Light Subsidiaries

Period Actual	Alabama to Georgia, Kw.-Hr.	Georgia to Alabama Kw.-Hr.
1921	5,959,136	.....
1922	44,646,400	3,313,200
1923	48,460,000	713,000
1924	18,400,000	806,000
1925	70,418,000	504,000
1926	222,684,003	3,112,000
1927	354,637,256	5,487,632
1928	203,978,658	28,243,145
Total	969,183,453	42,178,977
Budget, 1929	445,733,384	6,000,000
Total	1,414,916,837	48,178,977

The two largest electric service companies in the Southeastern group were interconnected before they were affiliated, energy having first been exchanged in 1921.

The transmission network totals 3,494 miles in length, with 4,140 additional miles of primary distribution and 8,266 miles of secondary distribution lines. Energy is supplied from 113 generating stations which have a total capacity of 1,109,332 hp. Of these generating stations 31 are hydro-electric plants having a total capacity of 867,795 hp. and 82 are steam power plants aggregating 241,537 hp. In addition to these owned plants there are twenty additional sources of power having a total capacity of 341,379 hp. available under contract or lease agreements. The installed generating capacity of the several operating companies totals 1,450,761 hp.

Service to 777 Communities

Electric service is supplied either directly or by wholesale contract to 385 communities in Alabama, 15 in Florida, 230 in Georgia, 112 in Mississippi and 35 in South Carolina, totaling 777 in number. In addition to electric service, fourteen gas systems are operated, five being located in Alabama, four in Georgia, three in Mississippi, one in South Carolina and one in Florida. Street railway or bus transportation is also furnished in 21 of the larger communities. In addition to these services there are subsidiary companies which supply water service to eighteen communities, steam heat to one community and ice to eleven communities. Coal mines, construction, land and realty companies are operated.

The growth of electric service in the five mentioned Southeastern states may be illustrated by the fact that

Table III—Growth of Southeastern Power & Light Company

Total Amount of Energy Supply and Related Items for the Past Three Years

Period	Energy Requirements, Kw.-Hr.	Generating Capacity, Kva.	Maximum Demand, Kw.	Electric Customers
1926 actual	1,969,183,662	964,780	419,280	205,838
1927 actual	2,215,946,923	986,953	475,000	234,574
Increase	246,763,261	22,173	55,720	28,736
over 1926, per cent.	12.5	2.3	13.3	14.0
1928 preliminary	2,369,000,000	1,189,000	525,000	281,396
Increase	154,053,077	202,047	50,000	46,822
over 1927, per cent.	7.0	20.5	10.5	20.0
1929 budget	2,682,000,000	1,250,000	600,000	300,000
Increase	313,000,000	61,000	75,000	18,604
over 1928, per cent.	13.2	5.1	14.3	6.6

for the year ended 1927 approximately 8.4 times as much energy was supplied as in 1912 and forecasts indicate that by 1940 25 times as much will be supplied.

The first attempt at a comprehensive forecast of Southeastern states resulted from work done by executives of various companies in conjunction with army engineers during the war. A report was presented in 1921 which recommended that additional sources of energy supply sufficient to produce 1,000,000,000 kw.-hr. be made available by 1925. It is rather interesting to note that the energy supply in the states involved had actually increased nearly 2,000,000,000 kw.-hr. by that time.

This forecast was followed by one conducted by seven Southeastern companies in 1920 covering a period to 1930 or 1935. Energy requirements forecast by this report have also been considerably exceeded to date.

During the latter part of 1926 an extensive and comprehensive commercial survey of the entire Southeastern Power & Light Company territory as it then existed was undertaken. It was felt that this survey should serve three purposes:

1. To show the commercial departments of the various companies the prospective load within their territory and give them a fairly definite schedule and goal for future activities.

2. To provide data concerning energy sales and demands from which engineering departments might study sources of energy supply, substation capacity and transmission line extensions.

3. The survey should also determine revenues expected from various geographical groups and companies so as to determine the most available business. It should also indicate total revenues expected so as to form a basis for the determination of the best methods of financing future growth.

Necessity for checking the results of the field survey by means of plots and application of experience of these companies and others was also realized.

In this territory, particularly where residential or commercial power extensions are concerned, consideration must be given to the proportion of negro inhabitants. It was found that for both urban and rural territory persons per family and per cent negroes have decreased with each successive census. Representative amounts for one state follow:

	1900	1910	1920	Estimated, 1940
Entire state				
Persons per family	4.9	4.7	4.6	.....
Per cent negroes	45.3	42.5	38.3	.....
Districts served by Southeastern Power & Light Company in this state				
Persons per family	....	4.39	4.08	4.02
Per cent negroes	....	40.4	34.4	26.5

At the time this report was made this company furnished residential service to 56.5 per cent of the total negro and white families in its urban and small town districts and, based on actual checks in a number of its operations, served 80 per cent of the white families and 15 per cent of the negro families. Assumption was made that by 1940 white saturation would be increased to 90 per cent and negro to 50 per cent of the families living in the districts then served.

In 1926 there was an average of 75 per cent retail power customers per 1,000 population with 9.1 hp. of connected load per customer and 7,110 kw.-hr. annual energy consumption. In projecting for future growth assumption was made that the number of retail power customers would increase at a slower rate than the population, but that energy use per customer would increase some 25 per cent to 50 per cent over that in 1926.

The United States Government census of 1920 indicated that there were 168,200 farms in the territory served by this company which produced and sold $3,460,000 of dairy products, $3,342,000 of poultry products and $17,557,000 of vegetables. It was felt that the production of dairy products would increase very materially and this type of agriculture lends itself very profitably to electrification.

Each of the principal classes of industry served was studied individually both as to present load and possibility of its growth, extension of present customers into new territory and location of industries not then existing in this territory. Considerable time and study were devoted to the possibility of industrial power growth because of the great bearing it has on amount of energy required, capacity of lines, substations, etc.

The Southeastern Power & Light Company has been operating for too short a time to have developed any growth factors for its entire system, therefore data relating to some individual operating company must be used. Percentage increase as applied to estimates of future business, particularly those covering considerable periods of time, are interesting, but must be used with care. For instance, an extremely high percentage compounded over a period of ten or more years may be entirely reasonable if the base amount is small and future operations are to be conducted over a relatively large and undeveloped area territory or one that has unusual industrial possibilities. On the other hand, a much smaller percentage may be reasonable where the base amount is large and the territory more fully developed. In other words, a mere comparison of percentages used to reach a conclusion or of percentages resulting from conclusions reached by other methods does not indicate the correctness or incorrectness of the results, unless taken in connection with a careful study of the conditions mentioned.

Table IV—Factors Relating to Energy Supply of Alabama Power Company

Period	Energy Requirements of Alabama Power Company Exclusive of Supply to Other States, Kw.-Hr.	Growth Ratio—Three-Year Periods	Growth Ratio—Four-Year Periods	Growth Ratio—Five-Year Periods
Actual				
1915	127,190,816	....	....	....
1916	188,000,905	....	....	....
1917	293,944,417	....	....	....
1918	401,364,567	3.16	....	....
1919	354,861,835	1.89	2.80	....
1920	488,135,725	1.67	2.60	3.84
1921	426,053,404	1.06	1.45	2.27
1922	567,502,777	1.60	1.42	1.93
1923	716,343,031	1.47	2.02	1.79
1924	797,360,861	1.87	1.63	2.25
1925	982,249,068	1.73	2.30	2.02
1926	1,170,508,622	1.63	2.06	2.74
1927	1,336,316,287	1.67	1.86	2.35
1928	1,294,250,332	1.32	1.63	1.81
Budget				
1929	1,461,945,601	1.25	1.49	1.84

This fact is conclusively proved by records of large public utilities in the United States. These records show that percentage increase is constantly decreasing and that the growth during the period when the company was small will not continue at the same percentage rate after it has attained a larger size, even though the territory served in the latter case may be larger and subject to great industrial expansions:

Commonwealth Edison Company, Chicago, Ill.—Consider, for example, the energy supply of this company. During the five-year period from 1895 to 1900 this item doubled in size in less than three years (an increase of more than 26 per cent compounded annually). In the period from 1900 to 1910 the growth continued to double each three years, but slowed down so that from 1910 to 1920 six years were required to double and the seven years preceding 1925 were required to double the energy supply.

Pacific Gas & Electric Company, San Francisco, Cal.—This company, which serves San Francisco and a considerable portion of California outside this city, is somewhat more comparable with "Southeastern." The energy supply of this company doubled in the five-year period from 1915 to 1920, while eight years preceding 1926 were required to double. The growth of this item was at a rate of 10.77 per cent compounded annually for the ten years preceding 1925 and 6.27 per cent compounded annually for the five years preceding 1925.

Table V—Local Fluctuations of Large Customers Influence Forecasts

Energy Sales per Customer Southeastern Power & Light:	**1926**	**1927**	**1928**
Energy sales, kw.-hr.	1,503,066,000	1,679,376,253	1,801,105,019
Electric customers, total number	205,838	234,574	281,396
Energy per customer, kw.-hr.	7,300	7,150	6,400
Alabama Power Company (affiliated company, sales deducted):			
Energy sales, kw.-hr.	954,656,319	1,048,201,154	1,054,076,141
Electric customers, total number	77,266	88,748	95,000
Energy per customer, kw.-hr.	12,400	11,800	11,100
Ohio Public Service Company:	**1923**	**1924**	**1925**
Energy sales, kw.-hr.	373,390,000	394,755,000	465,350,000
Electric customers, total number	62,765	87,641	94,105
Energy per customer, kw.-hr.	6,000	4,500	4,950
Detroit Edison Company:			
Energy sales, kw.-hr.	.....	.....	1,441,166,811
Electric customers, total number	.....	.....	455,092
Energy per customer, kw.-hr.	.....	.....	3,160

In order properly to outline the methods at present in use by the Southeastern Power & Light Company to forecast future results a brief outline of the departments concerned in their inter-relation is advisable:

As briefly outlined above, the Southeastern Power & Light Company consists of a number of strictly public utility operating companies, also construction, engineering and non-utility companies. Engineering is done by the Southeastern Engineering Company, which is a non-profit organization doing work for all of the subsidiary companies.

Table VII—Diversification of Energy Sales, 1927, of Southeastern Power & Light Company

Item	Sales, Kw.-Hr.	Ratio of Each Item to Total, Per Cent
Residential service	73,128,328	4.4
Commercial lighting	80,508,903	4.8
Commercial power	129,545,589	7.7
Industrial power	(1,376,050,998)	(81.9)
Brick plants	11,721,994	0.7
Cement plants	66,429,464	4.0
Coal mines	80,668,611	4.8
Cotton gins	6,102,358	0.4
Cotton mills	396,922,199	23.5
Cotton oil	35,800,694	2.1
Electrochemical	115,144,300	6.9
Feed and grist mills	1,052,381	0.1
Foundries and machine shops	23,061,065	1.4
Graphite plants	876,150	.....
Ice plants and creameries	46,516,490	2.8
Miscellaneous	23,059,776	1.4
Ore mines	16,859,630	1.0
Paper mills	5,072,643	0.3
Port facilities	952,138	.....
Public utilities	331,379,141	19.4
Quarries	27,921,669	1.7
Steel plants	158,735,700	9.5
U. S. Government	4,727,540	0.3
Water works	18,577,523	1.1
Wood works	4,469,529	0.3
Miscellaneous	20,142,435	1.2
Total	1,679,376,253	100.00

The new-business forces of the Southeastern Engineering Company then undertake actual field surveys of existing and of probable new customers, from which estimates of energy sales, customers and revenues are deduced. These results are checked by population growth, energy used by manufacturers and many other items taken from federal census and other reports. When the commercial forecast is completed it is turned over to the engineering division of the Southeastern Engineering Company, by which the indicated loads are plotted to determine load centers. These load centers, together with total energy requirements, are then studied to determine the generating facilities necessary, as well as to determine transmission line and substation requirements to carry the energy from its source to such load centers.

In Alabama and Georgia, with their considerable portion of hydro-electric energy and with variable river flows encountered involving both run-of-river and storage sites, a great deal of time is necessary to determine the proper co-ordination of hydro-electric and steam-electric stations. This subject is covered in a

Table VI—Energy Supply, Demand, Generating Capacity and Connected Load of Southeastern Power & Light Company

	Energy Supply, Kw.-Hr.	Maximum Demand, Kw.	Load Factor, Per Cent	Generating Capacity, Hp.	Generating Capacity, Kva.	Connected Load, Hp.	Ratio of Generating Capacity to Maximum Demand	Ratio of Connected Load to Maximum Demand
1925	1,196,244,494	284,000	48.0	750,000	424,275	638,749	1.50	....
1926	1,969,183,662	419,000	53.5	1,207,565	964,780	1,238,122	2.30	2.20
1927	2,215,946,923	475,000	53.2	1,252,655	986,953	1,353,796	2.08	2.12
1928	2,369,000,000	525,000	51.5	1,450,761	1,189,000	1,820,328	2.26	2.42
1929	2,682,000,000	600,000	51.1	1,550,000	1,250,000	1,850,000	2.09	2.30
1930	3,000,000,000	650,000	52.7	1,600,000	1,325,000	2,000,000	2.04	2.30
1935	4,800,000,000	1,050,000	52.2	2,100,000	1,700,000	2,700,000	1.62	1.92
1940	6,600,000,000	1,500,000	50.0	2,500,000	2,000,000	3,500,000	1.33	1.74

paper by W. E. Mitchell and J. M. Gallalee presented before the World Power Conference in Switzerland in 1926.

There are, however, many matters of policy and expediency involved in addition to strictly engineering features. In some cases construction of hydro plants must be started in order to comply with the federal water power license provisions. The cost of money frequently affects hydro-electric construction.

During the past ten years the presence of Wilson Dam has constantly influenced any plans that might be made in the Southeastern states. A potential source of power, varying with seasons and years from 100,000 hp. to 400,000 hp. and capable of producing 1,500,000,000 kw.-hr. annually of primary and secondary energy, cannot be overlooked in a forecast for that territory.

After the engineering division has completed its determination of probable capital additions, the finance or economic division continues the forecast by combining revenues, operating expenses and capital additions to determine a plan for financing the entire operations and finally arriving at surplus.

In forecasting growth we have found certain difficulties imposed by executive desires in addition to the many difficulties which are inherent in the problem.

Subsidiaries of the Southeastern Power & Light Company are located in adjoining territory, and while this fact is advantageous in many ways, it gives rise to some problems not encountered by companies whose operations are more centralized nor by companies whose operations are scattered throughout states not adjoining.

In spite of the fact that the territory served is continuous, considerable distances separate the various operations, which adds materially to the difficulty of collecting information and to variations in methods used in directing operations of the company.

Forecasting for the Southeastern Power & Light Company is rendered more difficult by the relatively large blocks of power used by comparatively few customers. As a result, fluctuation of load is likely to be accentuated. After all, however, forecasts serve merely to present pictures of results that may be attained. They do not go sufficiently into detail to present workable operating or financial plans. These must be provided by considerably more complete studies, which, in the case of the Southeastern Power & Light Company, take the form of annual budgets and continuous studies of future loads, generating plants, lines and substations.

These budgets are prepared in much more detail than the forecasts and present outlines for operating expenses, construction expenditures, cash requirements including new money, etc. Budgets are presented in such form that departure of actual from estimated results may be readily detected and they serve as the true operating plan.

Standardized Lighting for Filling Stations

By W. B. Pepper and D. P. Stone
Illuminating Engineering Departments
Charles H. Tenney & Company, Boston, and
Edison Electric Illuminating Company of Boston, Respectively

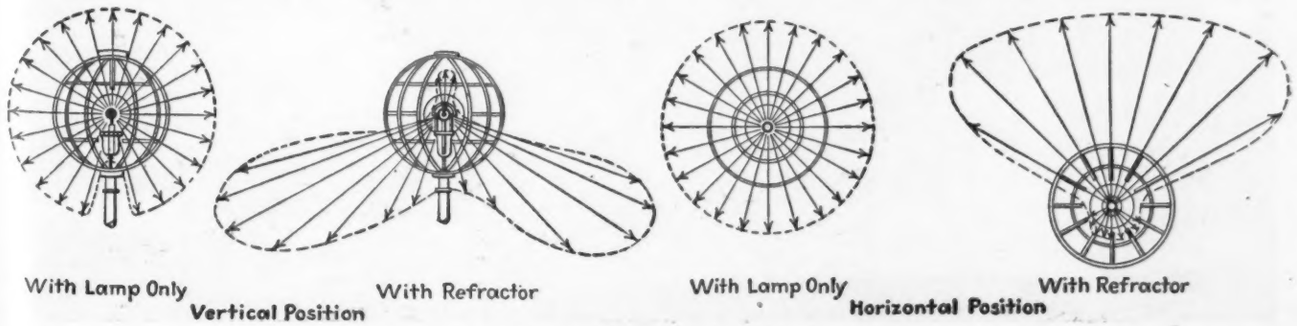
Close-up of new lighting unit

THE "Colonial" gasoline filling stations of the Beacon Oil Company are well known in the East on account of features of their construction which make them readily distinguishable to the motoring public. The lighting equipment has been prominent among these features from the standpoints of illumination and advertising and has recently been greatly improved through the co-operation of the illuminating engineering forces of the Edison and Tenney companies. Under the new arrangement of equipment an even intensity of 1 to 1.5 ft.-candles has been obtained at the test station, with about the same wattage as initially installed (1,900), and this can readily be increased if desired up to 5 or 6 ft.-candles by substituting 500- or 750-watt lamps and utilizing the improved type of units on all standards.

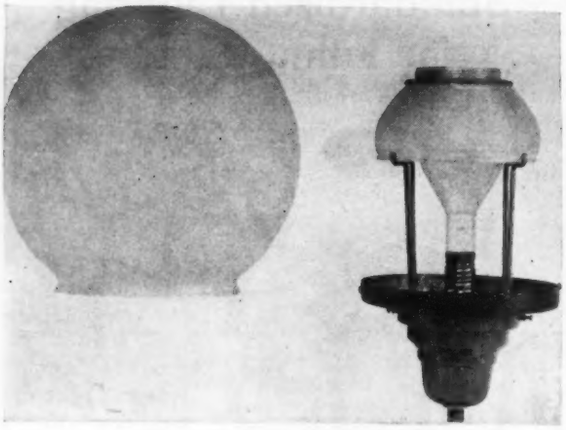
The original unit used in all "Colonial" stations consisted of a 16-in. x 6-in. opal glass globe inclosed within a spherical metal basket and mounted on a 3-in. diameter standard. A 300-watt clear lamp was employed, but the results were unsatisfactory since the major portion of the light was not distributed within the working area.

Trials at Typical Filling Station

A typical filling station was selected for trying various methods of solving the problem, which required the supply of efficient lighting without altering the outward appearance of the original equipment. An asymmetric prismatic refractor was selected and bowl refractors procured, but these were found to be too large to fit inside the opal globes. New globes were specially blown of the original 16-in. diameter but with neck openings of 10 in. By means of a makeshift wooden holder it was



Effect of refractor upon distribution of flux



Details of new unit, showing globe, refractor, supports and holder

found possible to assemble the equipment. Tests were run on this equipment and the following disadvantages uncovered: (1) The bowl refractors did not deliver the required fan-shaped distribution; (2) sharp shadows resulted from the network of the basket; (3) difficulty was encountered in assembling the equipment and in relamping.

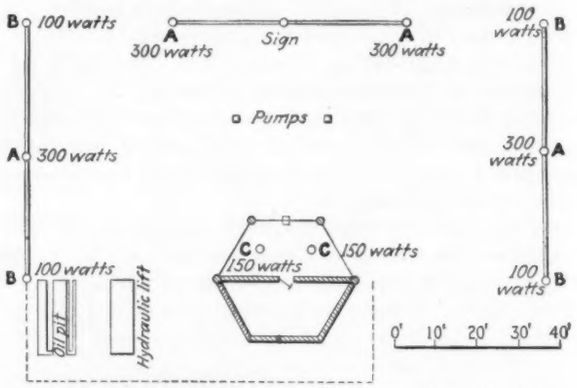
An asymmetric dome refractor was next used in place of the bowl refractor. A new holder with supporting arms for the refractor had to be made for this test. The results showed that the desired fan-shape distribution had now been obtained and that the difficulty of assembling and relamping had been eliminated, but that objectionable shadows were still present.

The problem now was to eliminate these shadows without destroying the distribution from the refractor. New globes with a very light opal flash were tried. The distribution remained practically unchanged but the shadows were still undesirable. Another set of globes with four varying degrees of acid etching was made up and tested. From these the correct degree of etching was determined and the final tests were made.

Four globes of the same density were obtained. Metal adapters, to support the refractors and the new globes, were attached to the old 6-in. holders. To all outward appearances the new units were the same as the original ones and it was found that the sharp shadows had been softened without destroying the distribution. The height above ground is about 14 ft. to the globe center.

These tests proved that the following requirements of proper illumination had been fulfilled: (1) Sufficient intensity for efficient station operation; (2) even intensity of illumination over the entire area; (3) freedom from glare; (4) elimination of sharp shadows.

The flexibility of the system is shown by the fact that the level of illumination in the yard may be raised, as stated, by means of an increase in lamp size to 500 or 750 watts. The distribution of light may be adjusted to provide an even intensity of illumination over practically any area by raising or lowering the light center.



A New unit with holophane G.E. asymmetric dome refractor and 300-watt clear lamp
B Old unit with 100-watt lamp
C Present units dropped so that bottom of reflector is level with lower edge of dome

Plan of typical filling station with lighting layout

The possibilities in energy sales range from 6,000 to 14,000 kw.-hr. per annum per station.

The above solution of the problem has led the Beacon Oil Company to adopt this equipment as a standard for all of its 300 stations.

The lighting units are wired each on a separate circuit to allow for flexibility in operation and the use of larger lamps when desired. The globes and holder adapters were supplied by the Graybar Electric Company and the General Electric Company furnished the Holophane refractors employed. Excluding wiring and installation the cost per unit was approximately $10.

Night view of typical improved filling station lighting

Rural Line Economics
in Maine

Results of seven years' development justify five-year amortization policy. One-sixth of the farms in central Maine served electrically

By G. S. WILLIAMS and W. F. WYMAN

Vice-President and General Manager and Distribution Engineer, Respectively, Central Maine Power Company, Augusta, Me.

AT THE suggestion of the ELECTRICAL WORLD the experience of this company in rural line development from 1921 to 1927 is presented to its readers in view of the wide interest of the power industry in the problem of serving the farmer. Beginning with 1921, the extensions made each year have been analyzed from the standpoints of investment requirements, revenue and return. The policies of the company are outlined and the trend of return upward noted as the extensions completed in each year respond to use and the passage of time. It is believed that no other company east of the Mississippi River serves so large a percentage of the farms in or logically a part of its territory. In round numbers the return on these rural extensions (which reach about 17 per cent of the farms) including lines, service loops, transformers and meters, but no internal equipment, ranges from 17 to 25 per cent per annum, depending on their years of service. Nearly $700,000 has been expended on these extensions during the past seven years.

In 1925 the company established a rural service department to work with the farmers in solving their electrification problems. Since then the progress in this field has been remarkable. Of the 50,000 farms in Maine, about half lie within this company's territory and about 4,000 more lie within areas which would logically be served by the Central Maine company if service were extended. Of this number 4,322 farms were receiving service at the end of 1927, so that about 16.5 per cent of the total number of farms in the territory are receiving service. Almost half of these customers were added during 1926-27.

BASIC POLICIES

While it is true that no definite rules can be laid down which will be capable of meeting all conditions in different sections of the country, the underlying principles of any successful rural electrification plan are essentially the same everywhere. The basic question is whether the farmer will be able to use, with profit to himself, sufficient electricity so that the return to the company will be at least equal to meeting the actual fixed charges and operating costs involved in serving him.

In making agreement as to the basis on which extensions will be made, our policy is personally to visit the individuals or committees desiring service and to go over with them the distance involved and the number of possible customers, an estimate then being made up by the operating department as to the actual cost of building the line. On this estimate is based the amount of return to be shown if the line is to be built. The prospective customers are then asked to guarantee (or help reduce) the investment, and the actual method followed may be one of the following three or a combination of these:

1. By an individual or collective guarantee of the necessary return for a stated period of years.
2. By a contribution toward the costs of construction in money, labor or material.
3. By an abatement of taxes for a period of years.

Summary of Rural Extensions Completed Since 1920, Central Maine Power Company

(Cents Omitted)

Year	Total Miles Built	Total Estimated Cost	Total Investment*	Contributions by Customers	Net Cost	Cost Bare Line
1921.....	38.8	$50,007	$51,711	$896	$50,815	$39,410
1922.....	33.25	39,032	43,861	5,032	38,829	32,030
1923.....	30.82	39,254	43,650	6,601	36,949	32,937
1924.....	23.4	39,708	40,924	2,695	38,228	32,520
1925.....	39.4	52,379	51,626	2,800	48,826	42,020
1926.....	104.3	201,456	205,493	35 037	169 655	121 800
Total....	270.0	$421,838	$437,267	$53,064	$383,303	$300,720
1927.....	114.9	139,392	147,129	6,441	141,687	108,835

Year	Cost Transformers, Services and Meters	Cost of Substations	Cost per Mile of Bare Line	Estimated No. of Customers	Customers per Mile	Investment per Customer	6 Per Cent Int. on Construction
1921	$11,551	.....	$1,013	365	9.4	$141	$53
1922	9,959	$769	963	271	8.1	161	301
1923	8,979	1,444	1,066	273	8.8	159	304
1924	8,243	.....	1,389	257	10.9	159	161
1925	8,201	.....	1,055	328	8.3	157	168
1926	27,490	5,592	1,167	718	6.8	286	2,150
Total	$74,426	$7,806	$1,112	2,212	8.1	$197	$2,219
1927	23,895	802	.....	625	5.4	238	526

*The investment includes the rural line extensions with poles, insulators, hardware, transformers, lightning arresters, substation equipment, if necessary, services and meters. It does not include any other equipment back of the extension or on the customer's premises.

The period over which the company now asks for guarantees is five years unless special cases occur, the theory being that a customer having agreed to pay for a certain amount of electricity monthly will equip himself to make use of the amount so paid for, and that, having done so, he will continue to do so after the expiration of the contract. Thus from a study of the above policies it is apparent that there are two main problems necessarily related:

(a) That where the customer is asked to guarantee a return on the investment construction costs are important and their control receives much attention. We insist on standard construction, and in laying out lines

plan for increased voltage if necessary to furnish ample capacity for future growth. Continuity of service is a major objective.

(b) That in order to insure the success of the five-year contract it is necessary to show the farmer in how many ways he can use up his guaranteed revenue and still do so with profit and convenience to himself. One of the main accomplishments of our rural service department has been in this field and will be discussed later.

Construction Problems

Our distribution systems in Maine include a few large centers, but for the most part serve smaller towns and villages with lines extending far into the country, so that immediately we are faced with a voltage problem as well as with an economic one. The roads vary in quality, but are being improved even in many remote areas. Ledgy ground prevails, especially in the coastal districts. Many well-wooded areas also exist. The tendency is toward increasing costs as rural extensions are pushed further afield. Higher voltages are required in some cases and in general we are now trying to meet the problem in the less accessible country. Owing to the attention paid to engineering construction economies, we have actually been able to reduce costs, and especially in the past two years have effected substantial savings by making certain changes in labor, tools and materials without sacrificing construction quality.

The labor cost in a pole line amounts to quite an item. Our regular line crews have headquarters at certain points, most of the city crews being paid fairly high wages. If they are away from home we have to pay a portion of their board. If we transport them to remote places expense arises. In 1926 we tried to overcome such expense by sending a trained man with a Ford truck into the field, authorizing him to hire his men locally. A considerable saving followed in actual labor as well as in board and expense. The plan has since been followed wherever possible. Another plan is to get work done at a unit price. In a number of cases we get holes dug for $1 each, against a former cost of $1.50 to $2. Often the customers getting service are glad to do this excavation as a contribution.

We have used a 1-ton Ford truck for the past two years and larger trucks when required. Holes are dug with a post-hole digger at an approximate cost of from $1.64 to $2.17 in fair ground where rocky soil is not a handicap. We use portable air compressors for drilling rocky material and so have cut costs somewhat here. Our standards of construction call for 30-ft. poles throughout, but in the past two years we have used 25-ft. poles on some extensions, making a difference in cost of $2 to $3 per pole. The 25-ft. poles are used only where joint construction would be impossible. This also in many cases enables the farmer to supply the poles as a contribution when he could not meet the former 30-ft. requirement. In recent years we have also made use of bare copper wire instead of weatherproof, making for No. 6 a difference of 30 lb. per thousand feet.

Native cedar poles are generally employed and the pole spacing ranges from 140 to 160 ft. In some cases aluminum wire is used. Extensions are usually single-phase, 2,300-volt, or 4,000-volt, four-wire lines, some 6,600-volt, three-phase and some two-wire, 6,600-volt service being used. For very long lines, say 10 miles, we use 11,000-volt, four-wire service.

Excellent progress has been made in the past two years in contacts with rural customers. The company has a representative fully acquainted with the details of farm work and his efforts to acquaint the farmers with the company's viewpoint have been marked with success. We are also co-operating with various farm bodies in an endeavor to line up new policies in rural electrification. Our rural agent is a member of the Maine Federation of Agricultural Associations, the New England Council and the Grange. A better understanding has been created between the company and the farming communities and this has spread to individuals all along the line.

To show the farmer what can be done electrically in his work we have completely electrified three demonstration farms in the poultry, retail milk and dairy fields. The College of Agriculture of the University of Maine is co-operating with us and extensive data are being obtained from individually metered apparatus units under the observation of Prof. M. D. Jones. The home economics department of the university is also interested in this work. The committee on rural electrification of the Maine Federation of Agricultural Associations is also actively interested in these demonstration farms. A very real interest in electric service on the farm is growing throughout our territory.

A check-up has lately been made of all rural construction on our system since 1920 and these figures show that in 1927 we built 175.9 miles of rural lines (total appropriation, covering some work completed in 1928) at a cost of $268,550, which is almost double the work of 1926 and about five times as much as any year previous.

Revenue from Rural Lines Rises with Years of Use

Year	Estimated Revenue	First Year			Second Year			Third Year		
		Meters	Revenue	Per Cent Return	Meters	Revenue	Per Cent Return	Meters	Revenue	Per Cent Return
1921	$9,075	286	$6,356	12.4	344	$9,481	17.5	389	$10,306	18.25
1922	8,468	208	4,497	10.9	317	6,880	14.1	363	8,737	17.5
1923	5,945	253	6,308	15.3	238	7,030	16.9	255	7,410	17.4
1924	8,215	226	7,282	18.2	258	3,290	19.9	307	9,706	21.9
1925	10,031	287	8,380	17.5	311	9,596	18.5	.....	.....	....
1926	35,836	829	39,628	20.2	.....	.....	....	.....	.....	....
Total	$77,569	2,069	$72,933	17.4	1,468	$41,079	17.3	1,314	$38,210	18.7
1927	$34,697	735	.....	....	.....	.....	....	.....	.....	....

Year	Fourth Year			Fifth Year			Sixth Year			Average, Revenue
	Meters	Revenue	Per Cent Return	Meters	Revenue	Per Cent Return	Meters	Revenue	Per Cent Return	
1921	448	$12,441	20.65	487	$14,423	23.5	587	$16,270	25.0	$11,546
1922	406	12,101	23.2	477	13,356	23.8	...	.....	....	10,231
1923	275	8,394	19.2	...	.....	....	...	.....	....	7,285
1924	...	.....	.....	...	.....	....	...	.....	....	8,426
1925	...	.....	.....	...	.....	....	...	.....	....	9,238
1926	...	.....	.....	...	.....	....	...	.....	....	39,528
Total	1,129	$32,937	21.2	964	$27,779	23.7	587	$16,270	25.0	.....

The accompanying tabulation gives the economic results of this work.

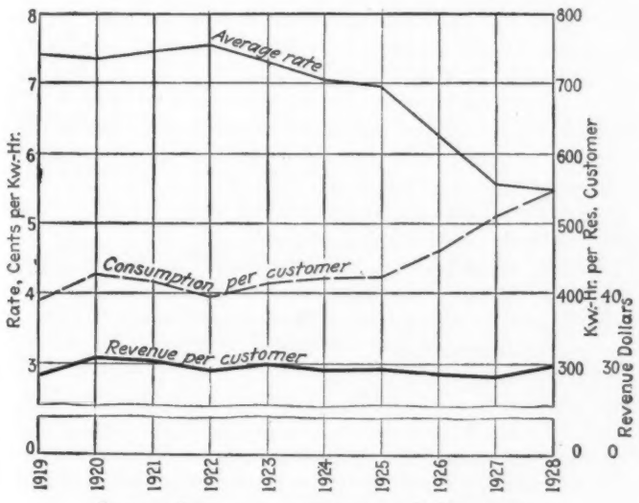
This analysis includes practically all the rural extensions built over this period. In some cases the extensions serve villages and summer business, but the company's policy is the same regarding all extensions, and the data are interesting even if they do not in every case represent purely farm business. In a few cases extensions have been omitted on account of being overbalanced by the presence of large power customers. As prepared, the years 1921 to 1926 inclusive were first summarized, and as the 1927 data were obtained later, these last have been added.

The data are presented for the individual extensions by years with a summary of the years at the end showing the return attained by cumulative use of the facilities. Interest is computed at 6 per cent on the contributions of the customers. In figuring the percentage return yielded by the revenue, this amount of interest is added to the revenue and the ratio of this total to the investment is shown as the return. Some extensions have shown a considerable increase in the number of meters added from the first year to the last. This increases the total investment, and to be fair we have added $50 per meter to the original investment whenever there is an increase in the number of meters over the first year of service.

Rates Downward, Revenue Stationary

THE trend of residential rates, consumption and revenue is very definitely shown in a tabulation in the year book and annual report of the Consolidated Gas, Electric Light & Power Company of Baltimore for 1928.

Perhaps the most striking feature brought out by comparisons covering the last ten years is the virtually constant average revenue per customer throughout that period, despite decreasing rates. In a most remarkable

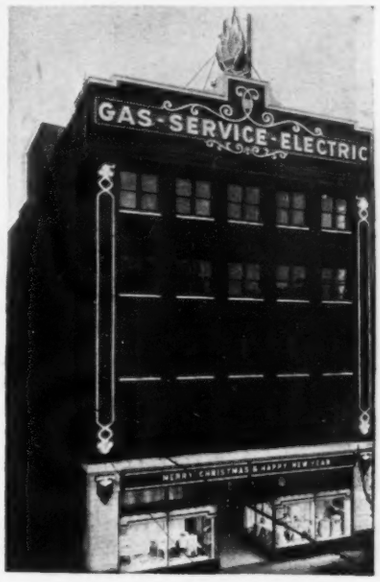


Increasing use counteracts falling rates

way changes in consumption have balanced changes in rates. The revenue has ranged between a minimum of $28.30 and a maximum of $31.37. In 1919 it was $28.65. In 1927 it was $28.30 and in 1928 $29.88. Rates, after minor fluctuations from 1919 to 1922, when they averaged 7.44 cents, decreased steadily to 5.48 cents in 1928. Meanwhile the consumption per customer rose from 390 to 545 kw.-hr. in 1928.

Setting Customers an Example

A CONSPICUOUS example of how a utility may show the way in electrical advertising is afforded by the displays on the new building of the Sioux City (Iowa) Gas & Electric Company. The elaborate character of the display is apparent from the accompanying picture. According to J. Hall Truman of this company, the flame effect at the top of the building is secured by the use of red, amber, orange and yellow lamps operated by a Hotchkiss "Silent Flasher," a product of the Cranblatt Manufacturing Company, Milwaukee, Wis. The words "Gas—Service — Electric" are also flasher-operated, so that the effect is of reading in the order, "Service—Gas—Electric-Service." The double side strips add the appearance of height to the building and burn continuously, as does also the scroll design across the top. Over the transom windows is an interchangeable letter sign on which seasonal and other messages may be shown. At either end of this are neon showers in colors. The control arrangement for the entire display consists of two magnetic breakers operated by Tork clocks. An interesting feature of the installation is that it is the first in Iowa to use the recently developed inside colored standard base lamps which were furnished by the Westinghouse Lamp Company through the McGraw Electric Company. The design and construction of the display is the work of the General Outdoor Advertising Company.



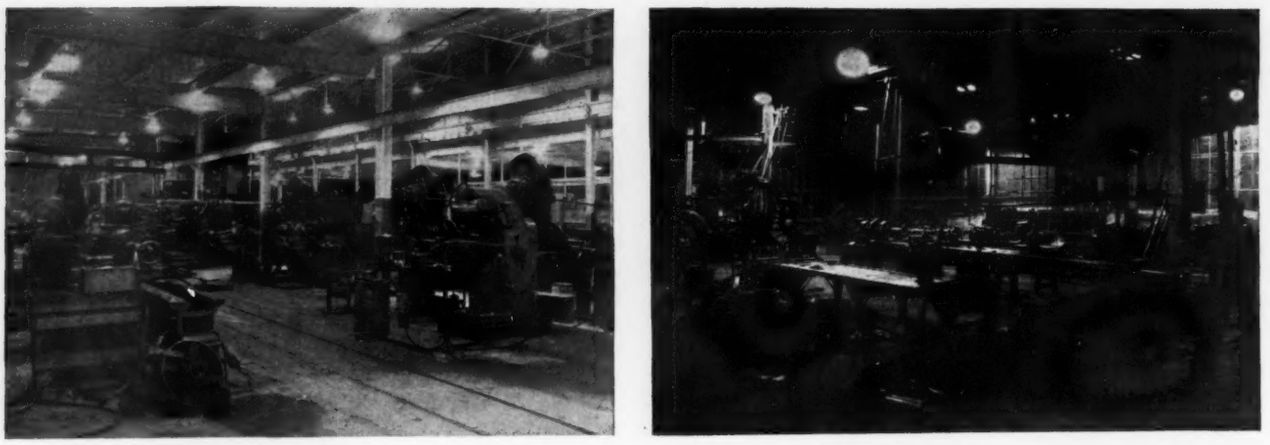
Setting a good example

Electrical advertising display on new building of Sioux City Gas & Electric Company.

The maintenance of this display has been adequately considered in the design. In each of the double strips an iron ladder, which is reached from the windows of the third and fourth floors, is permanently installed. Another ladder extending down from the cornice of the building on the side and near the front permits access to an angle-iron footrail extending across the front below the main sign. The flame effect can be reached by a ladder from the roof.

Table of Lamps in Sioux City Gas & Electric Company Sign Display

Location	Lamps	Size	Type	Color	Total Watts
Flame effect	675	10	S-14	R. A. O. Y.	6,750
Flame base	174	25	A-19	G	4,350
Channel letters	215	25	A-19	B	5,375
Scroll border	368	10	S-14	R. A. O. Y.	3,680
Side strips	1,000	10	S-11	R. A. O. Y.	10,000
Letter sign	168	60	P.S.	I.F.	10,080
Border strips	580	10	S-11	R	5,800
Showers	....	..	Neon	.....	.....
					46,035



"I want an installation exactly like that," said an industrial plant manager when shown the contrast between old and modern industrial lighting

Each of the illustrations above had a four-minute exposure and gives a true comparison between an old section of an industrial plant having 1½ foot-candles and a relighted section with an average intensity of 20 foot-candles.

20-Foot-Candle Intensity for Industrial Plant

CONSOLIDATION of several oil well tool manufacturers and the remodeling and enlarging of the shops of the Byron Jackson Company, Inc., Los Angeles, presented an excellent opportunity for lighting salesmen to sell the customer a better lighting job. Through the efforts of the lighting specialist of the Southern California Edison Company and manufacturers' representatives the customer was induced to abandon his plan to extend the old system of lighting and to install modern industrial units giving uniformly high intensity throughout the shop.

The accompanying illustrations show the striking contrast between the old and the new lighting. Where formerly 800 watts per bay, giving 1½ foot-candles, was used, there is now in the relighted section 4,000 watts per bay, giving an intensity of 20 foot-candles. In a section of the shop where special tools are made which require exacting machining the average intensity is 32 foot-candles. Storage spaces were provided with a minimum of 5.3 foot-candles, offices 15 foot-candles and the drafting room 25 foot-candles.

The lighting layout was made by a representative of the Holophane company and this company's equipment was used throughout. Officials of the Byron Jackson Company are highly enthusiastic over the new lighting installation and gladly indorse high intensity illumination to other industrial plant managers who view the installation. One large industrial plant manager took one look through the door of the plant and said, "I want an installation exactly like that." Later he decided to increase the intensity by 50 per cent.

Arc Welding May Be a Necessity

"ARC WELDING is not offered as a panacea for all troubles but as a manufacturing process that will eventually eliminate at least 85 per cent of all castings, forgings, and malleables and 100 per cent of all rivets in the design of all products now made by these methods," said J. F. Lincoln, president of the Lincoln Welding Company, at the recent New England Industrial Heating Conference.

"This substitution will be forced on all manufacturers because the change will result in a saving which on the average exceeds 25 per cent of the previous cost of the part designed.

"At first this saving can be pocketed by the manufacturer who applies this method. Soon, however, this advantage will disappear because of competition and the new method will be necessary if the manufacturer is to stay in his field at all."

Letters from Our Readers

Indirect Benefits of Socket Radio

To the Editor of the ELECTRICAL WORLD:

The editorial in the March 9 issue of the ELECTRICAL WORLD on "Radio Contributes Eleven Million Dollars" will undoubtedly do much toward emphasizing the importance of the radio as an additional load builder. I feel, however, that your estimate of the energy use resulting directly from the introduction of radios into homes equipped for electric service is far below that actually experienced. It is my belief that the "secondary" electrical load attributable to the use of radios is of even greater economic importance than the "primary" load represented by the radio equipment itself.

The introduction of a radio into a household effects changes of habits which materially influence the use of electricity. The number of hours of use of the home is undoubtedly greatly increased. People who have a radio to bring their entertainment to them stay at home more and go to bed later. The majority of them do not darken their homes while listening to the radio. Many of them are prone to indulge in percolated coffee, toasted sandwiches or other refreshments before retiring.

The $10,046,400 income based on the 60-watt ("average") radio set in use for twenty hours a week would be matched by that from a single 60-watt lamp in use at the same time. Is it not conservative to assume that the "secondary" load due to the increased use of an electrically equipped home because of a radio exceeds in amount the load represented by the radio itself? The former load is not as easily estimated as the latter, but it undoubtedly is the more important one.

H. A. BERG.

Chicago Central Station Institute, Chicago.

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Steam Generation at High Pressures and Temperatures.—ST. LOEFFLER.—This article is a highly interesting commentary on the generation and use of steam at high pressures and temperatures. It is also an argument for the superiority of the Loeffler "steam pumping" boiler over other existing types for successful service. In spite of the controversial nature of the author's argument the comparisons are presented here in the belief that they will stir up much-needed hard thinking on the subject and lead to worth-while discussions from interested readers. This first section of the paper deals with other types of boilers. The concluding part, to appear shortly, will discuss the Loeffler boiler. —*Power,* March 19, 1929.

Manitoba Power Company Completes Great Falls Development.—Few enterprises have contributed more to the industrial development of Manitoba and western Canada than the building of the Great Falls development on the Winnipeg River of the Manitoba Power Company, a subsidiary of the Winnipeg Electric Company. Situated about 12 miles above Lâc du Bonnet, it is one of the latest and most modern hydro-electric developments. A summary of the available power on this reach of the river under regulated flow of 20,000 sec.-ft. continuously throughout the entire year is 418,000 hp. The generators are of the vertical type, 20,000 kw. capacity, generating 11,000 volts, 60 cycles, alternating current, and are provided with 150-kw. direct-connected exciters.—*Electrical News (Canada),* March 1, 1929.

Transmission, Substations and Distribution

The Science of Cable Sheath Effects.—P. DUNSHEATH.—Although not unusual, it is sometimes advisable to employ single-core cables for carrying alternating current. At the high voltages now being adopted for bulk transmission the practice of employing single-conductor cables is increasing, but at the lower voltages it is only in exceptional circumstances, and usually only in short lengths. The changing magnetic field around a conductor carrying alternating current will, of course, generate electromotive forces in any metal in the vicinity, whether a lead sheath or an armoring tape or wire. If a complete circuit exists in which this emf. can cause a current to flow, then energy loss will take place. The magnitude of the loss in single-current cable sheaths depends on five factors: The current in the conductor, the frequency of supply, the dimensions of the cable, the distance between cable centers and the specific resistance of the cable sheath.—*Distribution of Electricity (England),* February, 1929.

Laws Governing the Allocation of Losses and Costs in Transformers.—G. PETROFF.—The author considers a line of transformers of given ratings, with the same utilization of electromagnetic material and with constant iron and copper factors. For this line he finds the conditions under which the losses and costs of the active material are a minimum. In addition, he investigates the influence of the short-circuit breakers on the main dimensions of the transformer and the effect of magnetic induction on the magnetizing current.—*Magazine of Theoretical and Experimental Electrotechnics (Russia),* November, 1928.

Rotary Converter Station, Thorndon, New Zealand.—In the earlier automatic substations of the Wellington City Council operation was obtained either by load demand, remote control by two pilot wires, or by means of a time switch, the operations of the gear being entirely automatic, including control of the machines and direct-current feeder contactors, and no direct indication is given to the main station operator. Supervisory control gear has been developed and used in the new substation to allow of full control of substation rotary converters and direct-current feeders by a central operator, while retaining the full automatic features. In either case the sequence of operations is as follows: The energizing of the master contactor completes the control circuit from an auxiliary transformer; as a result, the brushes on the machine are raised, the starting contactor and main oil circuit breaker are closed; should the machine build up with wrong polarity, a field contactor, controlled by a polarized relay, operates to correct it, a matter of two or three seconds only; the starting contactor is then opened and the running contactor closed, putting the machine onto full voltage; when the brushes are lowered and field built up, the machine is connected to the direct-current busbars through steps of limiting resistance, which are then cut out by shunting contactors if excessive current is not passing.—*Electrical Times (Australia),* January 26, 1929.

Generation, Control, Switching and Protection

Protection Against Short-Circuits in Three-Phase Industrial Plants. — W. KNOPFMACHER.—For economical reasons it is not always prudent to select the automatic circuit breakers, etc., for the short-circuit currents to be expected under normal conditions. Steps should rather be taken to limit them. The means to this end is chiefly the insertion of damping resistances in the conductors between the power station and the automatic circuit breakers. Another method is to provide the line itself with sufficient resistance. This increases the voltage drop in the line and is contradictory to earlier practice. The losses in the conductors are, however, of less consequence than the reliability of the plant and should not be regarded as the sole deciding factor. It will seldom be feasible to increase the voltage drop far enough to limit sufficiently the short-circuit current. Furthermore, the voltage drop may not be increased beyond a certain value (about 5 to 10 per cent, according to the kind of plant), in view of the inadmissible increase in the losses thereby involved. In such instances the desired damping effect can be attained by inserting reactance coils in series with the conductors. This has the additional advantage that the reactance if properly dimensioned cause but a comparatively small voltage drop in normal service, whereas at short circuit their damping effect is much more pronounced.—*A.E.G. Progress,* February, 1929.

Separation of Stray Load Losses in Alternating-Current Generators.—M. C. HOLMES.—A description of an experimental attempt to separate the stray load losses of a large alternating-current turbo-generator, making use of the fact that the loss in any of the various parts is proportional to the initial rate of temperature rise in that part. Comparisons are made between tests conducted with rotor structure removed and short-circuit tests.—*Journal of the American Institute of Electrical Engineers,* March, 1929.

Units, Measurements and Instruments

Master Frequency Clock. — A. RABINOWITSCH. — For satisfactory operation of synchronous clocks, time switches and other apparatus equipped with a synchronous motor it is essential to maintain the frequency of the system as constant as possible. The frequency meters commonly adopted for central stations do not entirely satisfy this requirement because they only indicate the momentary values of the frequency. Since the frequency continually fluctuates about the mean value, an ordinary reading solely provides an approximate idea of the average value of the prevailing frequency. A brief description of a master precision clock for the regulation of a system frequency.—*A.E.G. Progress,* February, 1929.

Switchboard Instruments.—E. H. W. BANNER.—The various types of indicating instruments in general use are detailed, together with the properties of each, including those of withstanding overload and freedom or otherwise from temperature and frequency errors, etc. Considerations on changing the range of instruments due to altered conditions

of use are given and, in the case of alternating-current instruments, the applicability to different frequencies. Ammeters and voltmeters are mainly dealt with, but all indicating instruments, wattmeters, power-factor indicators, synchroscopes and frequency indicators are within the scope of the article, while integrating meters are beyond it. Graphic instruments and relays are dealt with as far as they require instrument transformers, which are dealt with at some length. The B.E.S.A. standard ratings for instrument transformers are given and the consumptions for different types of relay.—*Electrical Review (England)*, February 8, 1929.

Electrophysics, Electrochemistry and Batteries

Probe and Radiation Measurements in the Copper Arc.—W. B. NOTTINGHAM.—The Langmuir probe has been used to explore the copper arc. The cathode fall of the normal arc has been found to be 20.5 volts, which equals the second ionization potential of copper, while the cathode fall for the hissing arc has been found to be 14.0 volts. The potential gradient along the arc stream is constant and therefore the space charge is zero and the concentrations of positive ions and electrons are equal. The average energy of the electrons throughout the arc is between 2.1 and 2.7 volts. The space potential, when measured with reference to the cathode, depends on the current flowing in the arc in the same way as the over-all potential. The positive ion concentration in the arc stream increases as the arc current increases. The light per unit volume has been measured for twelve copper arc spectrum lines.—*Journal of the Franklin Institute*, March, 1929.

The Prevention of Ionization in Impregnated Paper Dielectrics.—S. G. BROWN and P. A. SPORING.—An account of work which was undertaken in the first place to study the performance under various conditions of paper-dielectric condensers such as are commonly used for power-factor correction. It shows that breakdown of dielectrics in service is due to ionization of entrapped air and that, removal of the air being impossible, the design of cables and condensers should be such as to prevent ionization. The principle of this design is to subdivide the dielectric. The effect of surges in causing breakdown is indicated and a new test for finished products is suggested.—*Institution of Electrical Engineers (England)*, March, 1929.

Modulation of Light Waves.—ARTHUR BRAMLEY.—When light of a given frequency is passed through a dielectric, transparent to that frequency, which forms part of a parallel plate condenser, the light wave can be changed in character in two ways when electromagnetic waves of a given frequency are impressed on the condenser: First, the light, if it is initially plane polarized, will become elliptically polarized due to the medium becoming double refracting; second, the light train will be modulated. If the medium does not become double refracting, then the amplitudes of the modulated wave trains will be the same for corresponding frequency. When, however, account is taken of the double refraction of medium, the energy will be no longer equally distributed among the modulated wave trains toward the long and the short wave lengths side of the line, but there will be a greater amount of energy divided between the modulated waves on the long wave length side of the line than toward the other side.—*Journal of the Franklin Institute*, March, 1929.

Recombination Spectra of Ions and Electrons in Cæsium and Helium.—F. L. MOHLER and C. BOECKNER.—Thermionic discharges in cæsium and helium were operated to give strong continuous bands and spectrophotometer measurements of intensity distribution were made in connection with probe wire measurements of electrical conditions. Excitation of these spectra is favored by high electron and ion concentrations and low electron speed. Electrons have a Maxwell distribution of average energy of 0.15 and 0.4 volt. Intensity depends on the ion concentration independent of discharge current and voltage. The increase with ion current is less than the square and nearly the first power at high intensity. Intensity increases rapidly with pressure. By means of a sectored disk and commutator the spectrum of cæsium afterglow was photographed. It is characterized by a more rapid decrease in intensity of the continuous bands with decreasing wave length.—*Bureau of Standards Journal of Research*, March, 1929.

Traction

Heating Electrically Driven Trains.—W. LUTHI.—When electric traction was first adopted on main line and interurban railways in Switzerland the greatest attention was naturally turned to the locomotives themselves and in particular to the development of the traction motors and the method of transmitting their power to the driving wheels. There were, nevertheless, numerous other problems to be solved, which, although not of such outstanding interest, are very important as regards the satisfactory maintenance of the service itself. Heating trains electrically naturally falls within this category. The importance of this question was soon realized, as it represents quite an appreciable proportion of the cost of electric traction and, if given proper attention, can do much to increase the comfort of traveling. Direct electric heating was naturally adopted for tramcars, as, almost without exception, these are always built for purely electric operation. The problem as it concerns main line railways is, however, not so simple, because in the majority of cases large quantities of rolling stock already equipped for steam heating are on hand. In addition, the fact has to be taken into consideration that many of the coaches and wagons must be suitable for running on international lines from one country to another. Both these circumstances make it very difficult to decide what system of electric heating to choose.—*Brown Boveri Review*, March, 1929.

Miscellaneous

Thirty-five Years of Timber Treatment on the Illinois Central System.—A. F. BLAESS.—The Illinois Central System began the treatment of timber in 1903, and since that time has treated 52,009,662 crossties, 166,004,239 board-feet of lumber, 27,565,763 board-feet of switch ties and 12,970,450 lin.ft. of piling. As no substitute crosstie has been found, it seems that the solution of the problem rests with the betterment of the tie and improving methods of protection from mechanical wear. It is conservatively estimated that the use of treated timber on bridges has much more than doubled the life of such structures over untreated material. In the past thirteen years over 104 creosoted tanks have been constructed. It is estimated that the life of these tanks will be 40 years.—*Wood Preserving News*, February, 1929.

A Modern Dairy Installation.—By way of illustrating the importance that is attached to the use of electricity in the handling and treatment of milk, some interesting particulars and photographs concerning the application of the electric-driven milk depot of the United Dairies, London, Ltd., are given. The power supply is wholly electric, aggregating some 200 kw. Uses for power include lifts operated by 17-hp. motors and a chain conveyor using a 3-hp. motor, a "lowerator" (an apparatus similar to an elevator but for the reverse operation) using 1/2-hp. motor, a can-washing machine using a 10-hp. motor, brine circulating pumps using 3-hp. motors, etc.—*Electrical Review (England)*, Feb. 8, 1929.

Fitting Electrical Equipment to the New Job at Pittsburgh Cleaning Plants.—E. J. GEALY.—Early plans for the preparation plants of the Pittsburgh Coal Company indicated that the selection of the electrical and mechanical equipment would be important in assuring low cost of operation and the economic success of the program. It also was clear that inasmuch as the plants would represent one of the greatest forward strides ever made in bituminous coal preparation the choice of the equipment was not merely of slavishly following common practice but of choosing each piece of machinery for the specific job it was to do. The problem was twofold—the selection of equipment to duplicate as far as possible present stocks now held by the company and the determination of suitable types to harmonize with the new features of the plants. This necessitated consideration of equipment used in other modern bituminous plants as well as apparatus heretofore employed only in anthracite preparation, ore concentration or preparation plants abroad.—*Coal Age*, March, 1929.

News of the Industry

Ontario Premier Refuses a Return on Power Export

An effort made recently by the Liberal party in the Ontario Legislature to have more light thrown on the operations of the Hydro-Electric Power Commission met with vigorous opposition on the part of the government. The Liberal leader, W. E. N. Sinclair, introduced a resolution asking that there be laid before the House a return showing all contracts, letters written or received, memoranda, reports and documents of all kinds relating to the exportation of power.

Premier Ferguson said it was felt that the making of a public return would endanger the Hydro through unfair competition from private power organizations. He stated that there had undoubtedly been very definite attempts made to undermine the Hydro enterprise and attempts to create doubt in the minds of the people in a number of ways. This had been more definite in the last six or eight months than for some time before. Therefore it was not the desire of the government to give anybody any advantage in that respect.

More About Utility Activities on Pacific Coast

Activities of the Pacific Coast Electrical Association were examined into further by the Federal Trade Commission on March 22, in connection with the public utilities inquiry. Walter L. Frost, general commercial manager of the Southern California Edison Company and former president of the Pacific Coast Electrical Association, was the only witness.

The cost of associational activity, he testified, during the last few years has varied from $20,000 to $32,000. It is collected through the National Electric Light Association. The Light and Power Association, an unofficial group of electric company executives, he said in reply to a question of counsel, contributed between $5,000 and $8,000 annually toward the support of rural electrification experiments and research conducted by the University of California. Farm organizations, he said, also contributed to the movement. No pamphlets or books had been issued to schools or other educational institutions in California by the electric companies, he testified, nor had any surveys been made of textbooks. The association had distributed about 1,500 school pamphlets upon request, but they contained no propaganda.

The hearing set for Wednesday, March 27, was postponed until the following day on account of Judge Healy's illness. Witnesses scheduled to appear were N. W. Brockett of the Puget Sound Power & Light Company and A. E. Wishon of the San Joaquin Light & Power Corporation. The testimony of A. F. Hockenbeamer, president Pacific Gas & Electric Company, is postponed till April 16. R. H. Ballard, president Southern California Edison Company, has been indefinitely excused on account of sickness.

It is evident that the propaganda phase of the investigation is drawing to a close. In the period before the commission's data on utility finance is in shape for further hearings it is expected that counsel for the industry will be permitted to present the side of the utilities on this phase as promised by Commissioner McCulloch at the hearings last fall. Inasmuch as publicity activities on the part of power interests were more or less similar throughout the country, it is apparent that the commission deems one answer sufficient rather than hearing separate arguments from each region under investigation.

N. E. L. A. Convention Program

Innovations Include the Omission of Committee Reports and the Appearance on the Talking Screen of Men of Wide Fame

BRILLIANT simplification would perhaps be a suitable term to apply to contemplated innovations in the proceedings of the fifty-second convention of the National Electric Light Association, to be held at Atlantic City in the first week of June. Officials and committees are hard at work on the program, but it will be a few weeks before it can be printed even in tentative form. Two innovations have been decided on. One is the omission of formal committee reports and the discussions upon them which hitherto have played a major rôle in the proceedings and which not so many years ago were viewed as the main purpose of the convention. The other is the presentation in the form of talking motion pictures of a number of persons of worldwide fame in America and Europe, who, it is hoped, will discuss electricity and electrification from special viewpoints of their own.

In addition, there will be the usual quota of addresses from industrial leaders in America outside as well as inside the electrical industry. Each of the four national sections—Accounting, Commercial, Engineering and Public Relations—will hold one afternoon session, but only in one instance will these sessions be simultaneous. Orchestral and other music and the entertainment features will reach the customary high standards of N.E.L.A. conventions, while a special glamour will be cast on the convention by the semi-centennial celebration of Edison's invention of the incandescent lamp, which, as told in detail last week, will bring spectacular illumination on a large scale to Atlantic City, with its vast new auditorium and famous Boardwalk, as a precursor to a nation-wide jubilee of the same kind.

Skeleton Program of N.E.L.A. Convention

Friday, May 31:
6 p.m.—Exhibition opens.

Saturday, June 1:
10 a.m.—Registration starts.

Monday, June 3:
9 p.m.—President's reception.

Tuesday, June 4:
10 a.m.—First general session.
3 p.m.—Accounting session.
3 p.m.—Commercial session.

Wednesday, June 5:
10 a.m.—Second general session.
3 p.m.—Engineering session.

Thursday, June 6:
10 a.m.—Third general session.
3 p.m.—Public relations session.
9 p.m.—Public policy committee session.

Friday, June 7:
10 a.m.—Fourth general session.

Private-Company Power for New Subways in New York

On the advice of Stevens & Wood, who were retained by the city of New York to make a study of the power situation as it will affect operation of the new subway that the city expects to complete by 1932, the city is reported to have decided against building its own power plant and will probably seek to make a contract for ten years with a private power company. Legal requirements will necessitate advertisements for bids, but there is little doubt that the New York Edison Company and its associate utilities will be found the only feasible source of supply, the railroad companies which operate the existing subways having no power in excess of their own needs.

A proposed form of contract has been drawn up in which Matthew S. Sloan, president of the New York power companies, has suggested minor changes. No information as to the rates that would be charged is available, but when the final contract is drafted it is understood that it may contain a clause which would enable the city to cancel the contract in the event of a drop in power

rates and to negotiate for a new contract or to erect its own power plant. The final form of contract is expected to be ready about April 6. Estimated capacity necessary to handle the new subway load is 18,000 kw. for the first year, rising to 209,900 kw. within ten years.

A.S.M.E. Hears Steam Plants Described at Knoxville

Prominent among the papers presented at the spring meeting of the American Society of Mechanical Engineers at Knoxville, Tenn., last week was one by Prof. John M. Gallalee of the University of Alabama describing the new Gorgas steam-electric plant of the Alabama Power Company.

Professor Gallalee told how the 450-lb. pressure to be used in this plant was selected. Preliminary estimates were made for three cycles—450 lb., 650 lb. with boiler reheat, and 1,400 lb. with boiler reheat. In all three cases steam temperature was 725 deg., the vacuum 28 in. and feed water was heated from three bleed points. Studies showed that the three plants could be built for $95.50, $105.30 and $106.90 per kilowatt respectively, while the corresponding net heat consumption per kilowatt-hour was 16,000, 14,800 and 14,200 B.t.u. Using the assumed capacity factor of 40 per cent, the 450-lb. plant came out better than the 1,400-lb. plant, with the 650-lb. plant a bad third. Pulverized coal was selected as the best fuel for the plant.

Prof. F. C. Stewart of the Georgia School of Technology gave a comprehensive paper on "Factors in the Design of Boiler Furnaces," and H. H. Bailey described the design of the powdered-fuel standby station of the Tennessee Electric Power Company. Prof. J. A. Switzer told about the survey of the Tennessee River system by the Engineering Corps of the army.

Institute Meeting in Cincinnati

Oscillographic Studies of Lightning Surge Phenomena Provoke Discussion—High-Speed Excitation Also in Limelight —Excellent Series of Papers Characterize Meeting

A MOST interesting group of papers on lightning and other transients on power systems and their study by means of oscillograph records was presented at the regional meeting of the Middle Eastern District of the American Institute of Electrical Engineers at Cincinnati, March 20 to 22, inclusive. Quick-response excitation, high-speed photography, electric welding, mercury-arc rectifiers and current transformers were among other subjects also discussed. Purely on the basis of quality and number of papers, this convention of the second district was satisfying and very much worth while.

An experimental study of the theory of traveling waves was reported by K. B. McEachron in a joint paper with V. E. Goodwin on the study of artificial lightning surges on a short transmission line. The effect of conditions on the line and of apparatus connected to it on wave shapes and attenuation was shown. This was a progress report and in the discussion that ensued several suggestions in regard to the work to follow were made. The most pertinent of these was one not technical at all, to the effect that operating utilities might properly undertake a more active participation in this field of investigation, the greater part now being done by manufacturers.

The data presented by Mr. McEachron were obtained with a cold-cathode oscillograph. Complementary to this paper was a description of a hot-cathode type by R. H. George. This is a general-purpose instrument employing a new electrostatic method of focusing the electron beam which results in high photographic sensitivity at medium voltages. W. A. Marrison described two types of light-beam oscillographs which were developed for recording transient disturbances on communication lines induced from neighboring power circuits, disturbances whose times of occurrence are not known. One of these instruments makes use of a standard film on which the record is printed in a circle and is called a "polar oscillograph," while the other utilizes a continuous motion-picture film. Following this paper an interesting series of records of induced disturbances on communication lines were shown by M. Sultzer. The related subject of high-speed photography was discussed by H. W. Tenney.

Operating experience with fused arcing horns and grading rings on four 66-kv. circuits during three years was presented by Philip B. Stewart. The function of the fuses is to break the power arc after the lightning flashover of a line insulator, experience showing, Mr. Stewart said, that the fuses operate much faster than can breakers actuated by induction-type relays. H. C. Don Carlos questioned the necessity for such an extreme protective measure on multiple feeds and stated further that experience on the hydro-electric system in Ontario would not justify the cost of it from the standpoint of damaged insulators.

E. J. Burnham read a paper by J. R. North, I. R. Dohr and himself on an oscillographic test of a generator voltage regulator of the quick-response excitation type on a house-service alternator in a plant of the Consumers Power Company. These tests, according to the authors, permit the conclusion that this type of regulator is effective in reducing the magnitude and duration of surges from sudden changes in load. Discussion of this paper was much curtailed on account of lack of time, otherwise there would probably have been a repetition of the interesting and various views that this subject inspires whenever it is introduced.

The growing and widely spreading interest in the art of electric welding was evidenced by the strict attention given to the papers on arc welding of steel bridges and buildings by Frank P. McKibben and the fabrication of large rotating machinery by H. V. Putman and by the questions that followed them. Mr. McKibben explained the manner of making structural welds and showed the great economies in steel, time and labor that welding effects. Mr. Putman made out a good case for fabrication on the grounds of cost economy, speed of production and—in the mode of modern art—appearance.

A. M. Garrett described an installation of two automatic mercury-arc substations in Chicago on the system of the Commonwealth Edison Company. These are for traction service, and the decision for them was largely on account of the need to economize space in the congested "loop" district of the city. A modification of the two-stage connection of bushing-type current transformers permitting the use of ordinary single-current coil meters was described by A. Boyajian and W. F. Skeats, and the behavior of current transformers under surges of current was described by D. E. Marshall and P. O. Langguth. This paper, presented by Mr. Langguth, also suggested a method of design in which, the transformer core being kept below the saturation point, the errors in measurements of transients might be reduced. An analytical study of iron losses in turbo-generators by C. M. Laffoon and J. F. Calvert was presented by the latter.

Local electrical developments in Cincinnati were represented by two papers, one by J. A. Noertker on the recent rehabilitation of the street-railway system and the other by F. E. Pinckard on the low-voltage alternating-current network. The railway electrical system has nineteen automatic substations, including complete supervisory control and remote metering. The network paper set forth the problems that had been encountered and solved during fifteen months' operation and concluded with the statement that the network could be compared in reliability with the direct-current Edison system.

Gas-pressure testing of telephone cables to locate sheath breaks and improvements in methods of erection of cable lines were treated by B. S. Wagner and A. C. Burroway in a paper presented by the former. H. E. Mahan set forth the Department of Commerce regulations for the lighting of airways and airports and described the devices available for those services. A description of the electrical features of the new bar-plate and hot-strip mill of the American Rolling Mills Company by J. B. Ink completed the list of papers.

An interesting series of inspection trips rounded out a profitable and enjoyable meeting.

In the States' Legislative Mills

Governor Roosevelt's St. Lawrence Power Bill Killed—Carlton Exportation Bill Indorsed by Maine Committee —Scenic Preservation in Wisconsin

UNLESS Governor Roosevelt of New York carries out his threat of a special session and has better luck with it than with the one on the eve of adjournment as the ELECTRICAL WORLD went to press, his St. Lawrence water-power bill will lie for another year with other bills urged by him but killed by the hostile Legislature. A step further toward permitting exportation of hydro-electric energy was taken in Maine when the Carlton bill, described last week, was indorsed by the special water-power committee. Nothing of extraordinary interest is reported from other legislatures.

MAINE.—The special joint committee on water power voted 17 to 4 in favor of the Carlton bill for the export of surplus water power. The committee voted unanimously "ought not to pass" on the Oakes bill to repeal the Fernald law and on the Oakes compact bill. The committee left the Aldrich resolution for a recess investigation of the water-power situation open for further consideration after the Legislature has acted on the Carlton bill. No action was taken on a bill granting storage rights on Fish River, on the New Brunswick border.

A motion to kill a bill granting the right of eminent domain to electric power companies was defeated in the House by the casting vote of the Speaker.

A new measure introduced would tax all radio receiver sets $1. The resulting fund would be used to establish a department under the Public Utilities Commission to investigate and remove causes of radio disturbance.

MINNESOTA.—The Senate struck from the bill permitting municipally owned power plants to construct transmission lines to points 25 miles from the city limits the provision that would have permitted the city councils to contract for payment of costs out of future earnings. The bill as finally advanced to third reading requires a vote of the people on bond issues. It was also amended to apply to cities of all classes and to villages. Friends of the bill claim the amendment first stated will make it ineffective. The House committee in charge of a similar bill has reported it out with the distance limit cut from 25 miles to 10 and the future earnings clause eliminated. By the bill's terms construction of plant outside city limits cannot be financed other than out of accumulated earnings, taxation or bonds. Power companies have been opposing these bills on the ground that they lay the foundation for a socialistic state power company after a state-wide hook-up of municipal plants shall have been effected.

A Senate bill affecting municipal franchises has been amended to limit them to 25 years instead of 15 years as proposed. A 60 per cent vote is required on a franchise or lease proposal, the latter being limited to five years, as is also the power of a council to purchase energy for a municipal plant. The franchise rate is to remain the maximum rate, with power to companies to lower it at any time.

MISSOURI.—The House judiciary committee gave a hearing last week on the bill sponsored by the city administration of St. Louis to establish 7 per cent as the maximum rate of return for public utilities and requiring the Missouri Public Service Commission to detail the weight given to various elements in fixing rate-base valuations for utilities operating in the state. A section of the bill requires utilities to set out in more detail the proof in support of applications for higher rates. Under the measure the commission in a valuation decision must set out the specific weight given to original cost, reproduction cost new less depreciation and to other factors entering into the valuation. It also provides that when the commission has valued the physical property of a utility as a functioning concern and made proper allowance for working capital and construction overhead costs, no separate allowance for "going value" shall be made unless the commission sets out in detail its specific basis.

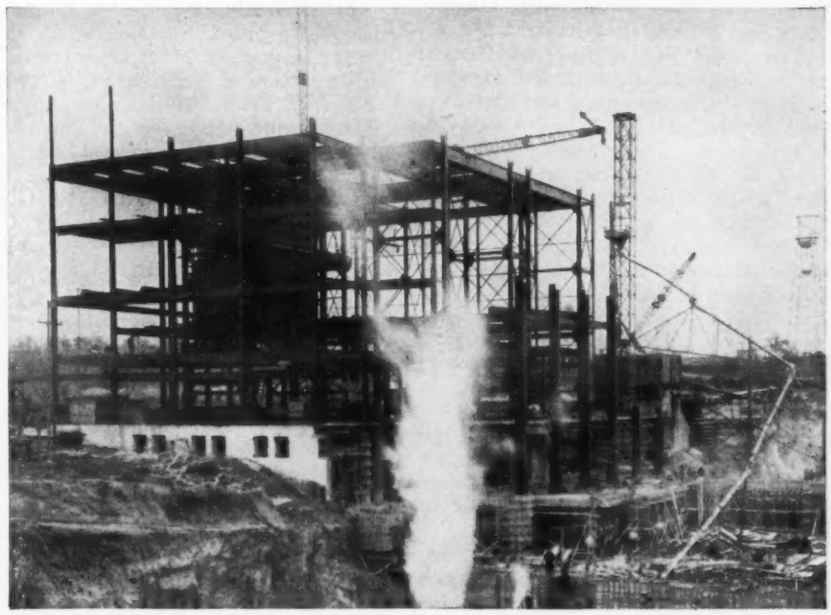
NEBRASKA.—The Senate killed, without discussion, one of the League of Municipalities bills designed to force cities and villages to adopt the plan of pledging future earnings in constructing plants. The bill provided that either this or the bond-issue method might be employed, but the limit placed on the amount of bonds that could be voted was so small that a plant could not be built with the proceeds. The House committee on cities and towns reported out for indefinite postponement twenty bills dealing with relations of municipalities with power companies in the matter of franchises and sales and purchases. Most of them were on the League of Municipalities program.

NEW HAMPSHIRE. — Proposed new legislation with support sufficiently strong to indicate its passage gives authority to the Public Service Commission to assess against utility companies the costs of investigations undertaken by the commission on matters brought before it by petitions of utilities.

NEW YORK.—Defeat met Governor Roosevelt's water-power bill, providing for the creation of a board of five trustees to plan a hydro-electric development on the St. Lawrence River, with distribution by private companies under contract, when on Tuesday the House refused by a vote of 20 to 20 to discharge the committee to which it had been referred. Twenty-six votes were needed to do so. The usual partisan fireworks shed their glare on the discussion.

Before this the Governor had sent a special message in which he urged that action be taken before final ad-

Pushing Big Duke Steam Plant to Completion



TO HOUSE the first 112,000-kw. unit for the Duke Power Company's steam plant at Riverbend, on the Catawba River, in North Carolina, work on the power-house structure is being expedited. Similar units are to be added as needed until the ultimate capacity of 450,000 kw. is reached, at an expenditure which is estimated at $20,000,000.

journment on his recommendation for the creation of a non-partisan commission to make a survey of public utility supervision by the Public Service Commission and of the public service law itself, with a view to remedial legislation by next year's lawmaking body. There were two bills pending—one the Sheridan-Sargent bill, which is supposed to be nearer what the Governor wants than the other, the Thayer-Dunmore bill, which was drafted and sponsored by the Republican leaders. The latter was reported and may have been put through in the final rush, adjournment being fixed for Thursday or Friday.

Under the provisions of a Senate bill a new section would be added to the Public Service Commission law providing that the commission shall not fix a value for rate-making purposes on so much of the property of a company under jurisdiction of the commission as was included in the company's latest annual report higher than the value placed thereon in such report.

OKLAHOMA. — The Black bill authorizing municipalities to own and maintain property outside of corporate limits and to issue bonds to acquire same has passed the Senate and gone to the Governor. Bills repealing or amending the revocable-permit law and others affecting the electric industry are still awaiting final action.

OREGON.—The Governor, together with many members of the recently adjourned Legislature, gives praise to those representatives of public utilities who voluntarily attended the session in the interests of their respective companies. This is probably so far the only state in the Union where the so-called "power lobby" has been allowed to assume the position of friendly counselor in legislative halls.

The State Water Code of Oregon as it affects the control and development of water resources was strengthened by the passage of six new laws, according to State Engineer Luper. Most important of these, he says, is the one which authorizes him to refer applications for permits to appropriate water that may prejudicially affect the public interest to the State Reclamation Commission for consideration and makes it the duty of the commission in approving or denying the application to regard the highest use of the water involved for any and all purposes. Second in importance, he believes, is the bill which gives the State Engineer full authority over all dams and other structures built for irrigation purposes the failure of which would result in damage to life and property.

By the other four measures the Engineering Department is invested with greater authority regarding water diversion, the Rogue River is closed to further hydro-electric development, the waters of Diamond Lake are withdrawn from future appropriation and justices of the peace have concurrent jurisdiction with the circuit courts in trials for violations of the Water Code. As regards Rogue River the statement is made in commission circles that all of its hydro-electric power sites were filed upon some years ago and, under the provisions of the new law, cannot be subject to interference. This being the situation, the Legislature merely passed a prohibitive measure affecting the appropriation of waters for power purposes which in no way applies to the development of projects proposed under the vested-rights clause.

WISCONSIN.—Power to consider the right of the public to enjoyment of natural scenic beauty and to deny a permit for construction of a dam when that right is judged more important than the water-power development is granted to the Wisconsin Railroad Commission in a bill enrolled by the Assembly. The bill also specifically provides that no dam can be built on the Wolf River Indian reservation in Shawano and Oconto Counties.

Purchases and Mergers

Chatham (N. J.) Municipal Plant Likely to Go to Jersey Central Power & Light—Acquisitions Sought by Southern Ohio Electric

UNDER a resolution adopted by the Borough Council of Chatham, N. J., last week, the borough's electric light and power plant will be advertised for sale to the highest bidder with May 6 set as the date for receiving proposals. The advertisement and a referendum to be held subsequently are, however, understood to be only the legal phases of a deal with the Jersey Central Power & Light Company, which has been in negotiation for the plant since last fall and is expected to be the only bidder.

The Ohio Public Utilities Commission has granted the Southern Ohio Electric Company of Athens leave to file an amended petition to purchase the United Ohio Utilities Company of Columbus for $2,230,740 and the Chillicothe Electric Railway, Light & Power Company for $641,828. The commission has authorized the Ohio Public Service Company to buy the Put-in Bay Improvement Company's distribution plant for $15,500.

Authority has been granted by the Maryland Public Service Commission to the town commissioners of Oxford to sell their lighting system to the Maryland East Coast Utilities for $25,000 and to the commissioners of Church Hill to sell their plant and equipment to the town commissioners of Centerville for $15,000.

Farmer City, Ill., has received an offer of $25,000 for its distribution system from the Inland Utilities Company, to which it has granted a 25-year franchise, with the option to the city of buying the Diesel-engine plant the company is to install at any time before the expiration of the franchise. The Inland company may not sell it without the city's permission.

The Indiana Public Service Commission has authorized the Indiana Service Corporation of Fort Wayne to purchase the Preble (Ind.) Light & Power Company for $20,000.

The Citizens' Power & Light Company, Council Bluffs, Iowa, has purchased the Iowa Power & Light Company, which serves Glenwood, Mineola, Silver City, Treynor, McClelland and Underwood, Howard Butler, manager of the Citizens' company, announces. The new owners for three years have furnished energy wholesale to the Iowa Power & Light, which has been a subsidiary of the Des Moines Electric Light Company, controlled by the Illinois Power & Light Corporation.

Chippewa Falls, Wis., will go to the polls April 2 to decide two municipal power proposals—the purchase by the city of the electric distribution system of the Northern States Power Company and the purchase of Glen Loch dam to supply power to operate the city water plant.

Sale of the Kinston (N. C.) municipal electric plant is again being agitated. It will be remembered that very high prices were offered the municipality last year by power companies for its plant, but the election at which the question was to have been submitted was called off.

The Georgia Power Company has purchased the municipal electric distribution system in Rutledge, Ga.

The Central Arizona Light & Power Company has purchased the electric light and power and gas utilities at Tempe, Ariz., for a consideration of $162,000. The company will construct a transmission line from its plant at Phoenix to Tempe at a cost of $60,000.

Twenty-five A.S.T.M. Committees Work at Chicago

The annual spring group meeting of committees of the American Society for Testing Materials was held in Chicago on March 19 to 22. The committees met early and late, starting with sessions in the morning and extending through the afternoon and evening with but one break, a dinner and entertainment on Wednesday evening. It was the first meeting held as far west as Chicago.

In all 25 committees of the society took part. The committee on copper wire recommended that the tentative specifications for bronze trolley wire be advanced to standard. It is making progress in the development jointly with the N.E.L.A. of specifications for wire and cable for use in transmission lines for electric power and is working in co-operation with the National Electrical Manufacturers' Association and the American Mining Congress in the development of standards for trolley wire for use in mines. A subcommittee on die-cast metals and alloys reported as outstanding developments unusual showings for soundness of die-cast parts made with certain aluminum alloys as revealed by X-ray examination and remarkable improvement in physical properties and stability of zinc-base alloys resulting from the use of special high-grade zincs. The committee on coal and coke approved five tentative standards for recommendation to the society for advancement to standard and two new tentative standards. In compliance with a request from the N.E.L.A., the committee on rubber products has undertaken the preparation of specifications for rubber gloves for voltages not exceeding 8,000 to ground.

Tacoma Asks Permit for Its Skokomish Project

Girand Applies for Two More Sites on Salt River—Fishery Men Oppose Wenatchee Dam—Raising the Level of Flathead Lake

APPLICATION from the city of Tacoma, Wash., has been made to the Federal Power Commission for a preliminary permit covering a site on the South Fork of the Skokomish River, 15 miles northwest of Shelton, where it is proposed to construct a masonry arch dam 280 ft. high and an earthen dike to form a storage reservoir with an area of 1,800 acres. From this reservoir it is planned to drive a tunnel 3½ miles long to connect with Cushman reservoir No. 1, now a part of the city's system. The water thus added to the Cushman reservoir will be utilized through existing and prospective power houses. The new site is expected to develop 39,100 hp.

James B. Girand of Phoenix, Ariz., has applied for preliminary permits covering two additional sites on Salt River. These, with a former application, completely cover the resources of that stream. One of the new applications proposes the construction of a dam 325 ft. high just below the junction with Carrizo Creek. At that point 14,000 hp. will be developed, it is estimated. A second dam 3 miles down stream from the Carrizo site will be 140 ft. high, and there 9,000 additional horsepower can be developed. The second application covers a dam 200 ft. high just above the mouth of Soldier Creek. This site will require the construction of a tunnel 49,000 ft. long, diverting the water 10 miles downstream. In this way an additional 8,000 hp. can be produced. The power is for the use of the copper mines of southern Arizona.

Protests against the Rock Island project of the Washington Electric Company on the Columbia River near Wenatchee are being received by the Federal Power Commission, most of them coming from fishing interests. They are similar in character to those presented at the time the Priest Rapids development was under consideration. The Rock Island project is 50 miles above Priest Rapids. In the Priest Rapids case the Federal Power Commission was convinced that it was entirely feasible to provide for the passage of salmon upstream over the proposed dam. The license issued in that case carried a provision requiring the installation of fishways. Inasmuch as the Rock Island dam is not a high one and will consist of a series of gates, it is believed that the problem of passing spawning salmon upstream and the fry downstream will be much simpler.

Acceptance by the commission of the application of the Rocky Mountain Power Company for a license covering the development of the power resources of Flathead River and Flathead Lake in Montana was urged recently by a delegation representing the Flathead irrigation district. Before the commission can act on the application it will be necessary to determine just how the ground water levels will be affected by raising the level of the lake. From what is known of the geology of the region it is believed to be entirely practicable to increase the lake level without affecting the ground-water conditions in the nearby cultivated areas.

The Glacier Silver-Lead Mining Company of Libby, Mont., has applied for a license covering a small plant in operation on Granite Creek.

Charles F. Bradford of Sacramento, Calif., has applied for a preliminary permit covering a project on the North and Middle Forks of Cosumnes River, in El Dorado County, Calif. It is planned to build a dam 200 ft. high on North Fork and also a dam on Middle Fork 140 ft. high, with a power house on the North Fork. Estimated capacity is 12,300 hp.

The Texas Central Power Company of San Antonio has filed a declaration of intention covering a project on the Guadalupe River. It is proposed to build a 35-ft. reinforced-concrete dam 480 ft. long across the Guadalupe River 14 miles northwest of Victoria, Tex., and to install 3,000 hp.

T. J. Yerby of Bishop, Calif., has applied for a minor license covering a proposed development on Rock Creek, Mono County. The power is to be used for lighting purposes.

Merrill on "Administrative Problems of Superpower"

Speaking from the standpoint of the government, federal or state, **O. C. Merrill**, executive secretary Federal Power Commission, discussed in an address given at Yale University on March 20 "The Administrative Problems of Superpower." He touched on the interstate transmission and sale of electrical energy, indicating dissent from the view that since less than 10 per cent of power generated enters into interstate commerce it is a matter of small importance which the states can handle either individually or jointly. In 1926, Mr. Merrill said, South Carolina exported 31 per cent of her generated power, Georgia 38 per cent, West Virginia 43 per cent, Iowa 48 per cent, Idaho 63 per cent and Vermont 94 per cent. The percentage of imported power to power generated within the state was 40 in Kentucky, 75 in Maryland, 98 in Mississippi, 116 in Missouri, 121 in Utah and 126 in Nevada. Mr. Merrill called attention to the Federal Power Commission's proposal that Congress in legislating on this interstate traffic grant power to the state commissions to act as its agents within certain limits, leaving wholly to the states those cases where interstate commerce is not directly affected and in other cases authorizing the state commissions, sitting jointly, to hold hearings and make the original findings, leaving to a federal agency final jurisdiction in case of disagreement, appeal or non-action.

Mr. Merrill dealt also with the regulation of holding companies. His remarks under this head are printed on page 631.

Three Hydro Dams Go Down in South Alabama Floods

Authentic reports from southern Alabama to the ELECTRICAL WORLD bring to light a fact overlooked in the press reports of the recent heavy floods in that region. This is that owing to the washing away of the earth embankments at the ends of three concrete hydro-electric dams belonging to the jointly owned Pea River Power Company and River Falls Power Company, these dams failed. As a result a 2,000-hp. plant at Elba, a 7,000-hp. plant at River Falls and a 3,200-hp. plant at Gantt were put out of commission. Called upon to help in the emergency, the 900-kva. steam plant at Andalusia soon had to shut down because of the impossibility of getting more fuel and a small municipal steam plant at Luverne caught fire and burned down.

As a result electric service is at a minimum in the territory served by the various plants named. It is considered likely that the Alabama Power Company will extend its power lines to the places deprived of service. No announcement concerning plans for rebuilding the dams has yet been made by the Pea River and River Falls companies so far as is known.

As printed last week, the Alabama Power Company reports its transmission system in the inundated district as back to normal. No damage was done at Flomaton, where the Alabama company has a large substation and whence the 110-kv. line from the hydro plant at Lock 18, on the Coosa River, branches off for Mobile, Ala., and Pensacola, Fla.

Impact from a broken highway bridge washed down by the flood injured the Georgia Power & Light Company's dam across Spring Creek, near Bainbridge, Ga., to the extent of $15,000, a report from Valdosta says.

Flood Troubles in Mid West

Flood conditions on the Mississippi River last week seriously handicapped the hydro-electric plant at Keokuk, Iowa, where the river is said to have reached its highest stage for thirty years, and the Illinois Power & Light Corporation, it is reported, had to turn to other interconnections to handle part of the load on its western distribution systems usually supplied from Keokuk.

High water in the Cedar River threatened service in towns and cities supplied by the Iowa Public Service Company. Emergency crews from the utility company were rushed to points where interruptions were reported, made hasty temporary connections and kept the service in a remarkably efficient state in view of widespread damage to lines and flooding of minor plants. The Vinton (Iowa) municipal plant was forced to suspend service for two days when rising waters flooded the station.

The Kentucky River flooded the plant of the Kentucky & West Virginia Power Company at Jackson, Ky., on March 22, causing suspension.

Mohawk-Hudson Budget

Eight-Million-Dollar Program Includes Hydro Plant at Conklingville, on the Sacandaga, but Hudson River Plant Has Not Reached Building Stage

PLANS have been prepared and it is expected that bids will be taken within the next two months by the Mohawk-Hudson Power Corporation (holding company for the New York Power & Light Corporation) for a hydro-electric power house at Conklingville, Saratoga County, to utilize the flow of the stream made possible by the newly erected Conklingville dam, which is a part of the Sacandaga reservoir development under supervision of the Hudson River Regulating District Commission. This project will, it is estimated, cost about $700,000.

Plans for a much larger development at Hadley Falls or Palmer, on the Hudson River, have been in contemplation by this company for some years and were recently referred to in newspaper reports as if ready for putting through. Inquiry at the offices of the corporation in Albany, however, brings out the information that nothing is expected to develop regarding this project this year.

The Mohawk-Hudson company contemplates a budgetary expenditure of upward of $8,000,000 in 1929 in connection with general upkeep, improvements and repair of its power houses and lines, but no major projects are included. About $500,000 will be expended in the Albany territory served by the New York Power & Light Corporation, where work covering a change from 40-cycle to 60-cycle frequency is under way. The $8,000,000 includes construction of rural lines, building of conduits, replacement of old cable and installation of new and miscellaneous work.

Experimental work conducted by the New York Power & Light Corporation in the color floodlighting of buildings is attracting attention outside of Albany. The first successful utilization of floodlighting for commercial display purposes was, it is said, undertaken by the Municipal Gas Company of Albany (now owned by the New York Power & Light Corporation) three years ago.

Southern California Edison's Attitude on Boulder Dam

The attitude of the Southern California Edison Company on the Boulder Dam project is expressed by John B. Miller, chairman of the board, in a letter mailed to the company's stockholders with a recent dividend notice. Because the annual report of the company for 1928 would not reach stockholders until late March or early April, Mr. Miller gives a résumé of the company's status and quotes from the annual report an excerpt on the Boulder Dam project. The excerpt concludes:

So far as the project affects your company's interests, it is believed that the construction of this huge enterprise, including as it does a plant to divert an enormous amount of the impounded Colorado River water into the territory served by your company, will stimulate growth and prosperity in southern California with attendant increase in demand upon the company for service. It will be your company's policy to co-operate with the federal government and with the other agencies now distributing power in southern California in working out plans for developing and distributing the power, to the end that the project may proceed as rapidly as possible. It is unlikely, in view of the period required for construction and of the delays which apparently must ensue before construction is started, that any power will be available from the project within the next ten or twelve years.

Boulder Dam will take ten or twelve years to complete, and if at that time power is developed, it will add a substantial new supply for this territory. The normal increase of your company's business during these years, while the dam is under construction, will enable us easily to absorb our share of this block of power.

Progress of Rural Service in Alabama Counties

The electrification of farms and farm homes made remarkable progress in Alabama in 1928, when new customers were added at the rate of 187 per month, the work being done by the Alabama Power Company in co-operation with the experiment station and extension service of the Alabama Polytechnic Institute. An official report reveals that 867 miles of rural electric lines were in service at the end of 1928 and that they were serving 5,964 customers. At the same time 40 additional lines were under construction or had been authorized. When complete these lines will add 144 miles and will serve 630 additional customers. This progress is greatly in excess of any of the four former years of rural electrification in Alabama.

Data on the work were compiled by E. C. Easter, chief agricultural engineer of the Alabama Power Company, who has been connected with the work continuously since its beginning. His report says that rural transmission lines have been extended into 44 of the 67 counties.

Virginia Organizes a Farm Electrification Committee

Organization of a special committee to study the administrative details of a farm electrification plan suitable for Virginia has been announced by the Virginia State Commission on Conservation and Development. The committee is composed of R. J. Throckmorton, C. F. Schoonmaker and W. I. Whitfield, representing the power companies, and C. E. Seitz, G. C. Boyer and E. O. Fippen, representing the state. It is the result of a meeting at Richmond of the state-wide farm electrification commission, a group made up of Floyd W. King, J. W. Hancock and T. Justin Moore, power-company men, and W. E. Carson, W. Stuart Moffett and Dr. Julian A. Burruss, representing the state. This commission was established by Governor Harry F. Byrd following a general conference.

Much progress in the technical study of the movement was reported. The plan favored involves a standardization of contracts and close supervision. The commission hopes to work out a method of establishing electric service in rural sive and just to consumer, company and districts which will be just to all.

Good Advice, Spirited Debate for Northwest Accountants

Money-saving systems in billing customers, a mode of presenting fundamental statistics to the management graphically and the importance of fixed-capital records in arranging fire insurance schedules were among the more important subjects raised in the committee reports presented at the general conference of the Accounting Section, Northwest Electric Light and Power Association, held at Portland, Ore., March 18. All committees reported and discussion was frank and spirited. The meeting was presided over by A. E. Janssen, Idaho Power Company, Boise, section chairman.

R. M. Boykin, Puget Sound Power & Light Company and president of the association, cited many ways in which the accounting department could assist in building good public relations, could foster commercial development and could render aid to the busy executive by interpreting the financial history of the business from the standpoint of its economic significance.

M. J. Wilkinson, Pacific Power & Light Company, Portland, Ore., responding as vice-chairman of the section, pointed to some of the accomplishments of the section in the past and urged the section to consider itself a service department for the member companies, for the other sections and for the utility customers.

In addition to these general talks, F. W. Brownell, Puget Sound Power & Light Company, Seattle, outlined the scope of the section's activities as including, besides co-operation with the national committees, also the making of itself a service organization for the Northwest member-company executives.

Soviet Will License Stations Rated at 500,000 Kw.

Openings for concessions covering central power stations in the Soviet Union, as recently announced by the "chief concessions committee," involve ten projects ranging from 20,000 kw. to 200,000 kw. in rating and amounting in the aggregate to more than 500,000 kw.

The largest concession listed is for a steam-electric central station in the Moscow region. This station is expected to have a capacity of from 150,000 kw. to 300,000 kw. Other openings are for a hydro-electric station on the Svir River of 80,000 kw. capacity, which may include high-tension transmission lines to Leningrad, 143 miles distant, and for a 60,000-kw. central station at Cheliabrinsk.

Briefer News

WATERLOO (IOWA) GENERATING PLANT BEING ENLARGED.—Installation of a 3,300-hp. high-pressure boiler in the central generating station of the Iowa Public Service Company, Waterloo, is about to start, and the work will be completed by October 31, at a cost of $225,000 it has been announced by R. H. Garrison, manager of the Waterloo division of the company. The addition will make the Waterloo plant the largest in that section of the state.

CONTRACTS LET FOR COBBLE MOUNTAIN PLANT AT SPRINGFIELD, MASS.—Construction contracts have been let for the generating plant which is to be built in connection with the Cobble Mountain reservoir that is being carried through by the city of Springfield, Mass. This plant, to be ready next year, will be leased to the Turners Falls Power & Electric Company at $270,000 a year and will represent the equivalent of a 23,000-kw. steam generating station.

UPSTATE NEW YORK RATE REDUCTIONS APPROVED.—The New York Public Service Commission has approved the new rates of the Syracuse Lighting Company applicable to household users of electricity which were noted last week (page 606). The commission has also approved a new schedule of the Rockland Light & Power Company applicable to Haverstraw, Nyack and other places which effects a saving of 1 cent a kilowatt-hour for commercial and residential lighting with incidental heating or motor service up to 1 hp. installed capacity.

BULL RUN IS NOW SITE OF RURAL POWER PLANT.—After about five years' effort on the part of enterprising farmers living near historic Bull Run, Va., a 500-hp. plant has been built on the stream by a local stock company at a cost of $50,000, and 50 customers at Clifton Station as well as 25 farms in the vicinity are being served. A tie line to Manassas has also been constructed. More customers are constantly being added. The project was carried to completion under the supervision of J. A. Waller of the Virginia Polytechnic Institute at Blacksburg, the agricultural division of which is actively concerned in furthering electric farm service.

MORE APPLICATIONS FOR POWER SITES IN OREGON.—The Portland (Ore.) Electric Power Company has filed application with the state engineer for authority to store 100,000 acre-feet of water from the Main Fork of the Clackamas River for the purpose of power development. This filing is in line with the company's program for completing its Oak Grove project. Oregon Farms, Inc., a Portland corporation, has asked the engineer for a permit to store 25,000 acre-feet of water from Clear, Fish, Lava, Lost, Mud and Big Lakes and the McKenzie River and to appropriate 600 sec.-ft. of such stored water for the development of power in Linn County.

POWER DEVELOPMENT IN NOVA SCOTIA. — At the power sites on the Mersey River in the Province of Nova Scotia, Canada, work is being pushed forward by a force of more than 1,100 men. Three sites are being developed by the provincial government through the Nova Scotia Power Commission. The total capacity will approximate 31,000 hp., of which 20,000 hp. is to fulfill a contract with the Mersey Paper Company.

INTERNATIONAL POWER CABLE ACROSS ST. CROIX RIVER BETWEEN MAINE AND NEW BRUNSWICK.—The Secretary of War has approved the application of the St. Croix Gas Light Company of Calais, Me., for a permit to lay and maintain an armored submarine power transmission cable across the St. Croix River between the towns of Robbinston, Me., and St. Andrews, New Brunswick, provided that a presidential license be obtained, as this cable will make a physical connection between the United States and the Dominion of Canada.

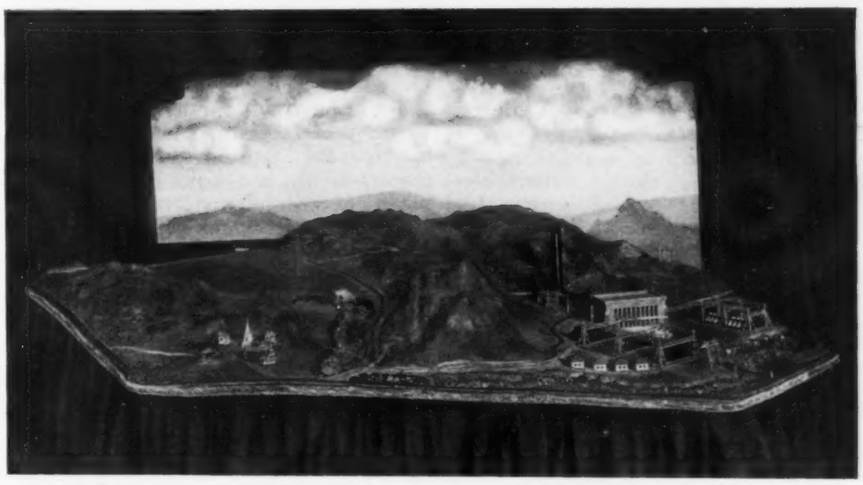
DALLAS FINDS PURCHASE OF ENERGY THE CHEAPEST MEANS OF OPERATING CITY PUMPING PLANT.—On comparing bids for operation of its central pumping plant, the City Commission of Dallas, Tex., found that the advantage lay with purchased energy from the Dallas Power & Light Company, as compared with three other methods—steam, Diesel engines and gas engines. Equipment for steam operation would, the report says, cost $265,000 more than electrical equipment. An exceedingly favorable rate from the power company also demonstrates, it is said, that electricity will be more economical in yearly operating costs.

POPLAR BLUFF MUNICIPAL PLANT BOASTS THIRD LOWEST RATE IN MISSOURI.—Only two cities in Missouri—Hannibal and Chillicothe—have a lower light rate than Poplar Bluff, according to a tabulation by A. E. Hecker, superintendent of the municipal plant there. The Poplar Bluff rate for 50 kw.-hr. is $3.23, while the rate at Hannibal is $3.15 and at Chillicothe $2.57. The municipal plant at Poplar Bluff recently reduced its rate 20 per cent.

PENNSYLVANIA - OHIO POWER & LIGHT TO ERECT OFFICE BUILDING.—An office building which will cost about $750,000 and will be eight or nine stories high will be constructed at Youngstown, Ohio, next year by the Pennsylvania-Ohio Power & Light Company, according to announcement by President C. S. MacCalla. The building will be constructed on the site of the present general offices at Boardman and Champion Streets, and the lot next to that site will also be utilized.

CONSOLIDATED GAS & ELECTRIC GETS DISPUTED TERRITORY. — A vigorously waged contest for the right to serve four summer communities in Calvert County, Md., along Chesapeake Bay, has been settled by the Maryland Public Service Commission in favor of the Consolidated Gas, Electric Light & Power Company

Harriman Station on Deerfield River Modeled



A PORTABLE model of the Harriman hydro-electric development of the New England Power Association on the Deerfield River in southern Vermont has recently been built for demonstration purposes by the engineering and maintenance staff of the power company with the co-operation of the Alden Hydraulic Laboratory of the Worcester Polytechnic Institute. The model is 10 ft. long and 6 ft. wide and shows in miniature the Davis Bridge dam, spillway outlet, power tunnel, surge tank, power house and switch yards of this 60,000-hp. development, with the natural surroundings in color. A motor-driven water circulation is included to simulate the flow of water through the spillway, tunnel system, power house and river. The dam and spillway are reproduced on a scale of one to four hundred and the powerhouse section on a scale of one to one hundred.

of Baltimore. The controversy hinged largely on rates and was with the Suburban Electric Company, which serves other sections of Calvert County. The Consolidated company will have four months to complete a connecting line.

COMAL PLANT OF SAN ANTONIO COMPANY READY FOR INCREASED OPERATION.—Repair of the original 30,000-kw. turbo-generator in the Comal plant of the San Antonio Public Service Company at New Braunfels, Tex., which has been under way for some time, is finished. While it was proceeding the new unit, which has the same rating, handled the load. The plant is now ready for operation at 60,000 kw., according to D. W. Flowers, superintendent gas and electric departments.

OTTER TAIL POWER COMPANY HAS MILLION-DOLLAR BUDGET.—Announcement has been made by Clifford S. Kennedy, general manager Otter Tail Power Company, Fergus Falls, Minn., that the company plans to rebuild its distribution systems in thirty towns and villages, including Fergus Falls, at a cost of $300,000. Various projects bring the estimated expenditure for the next fiscal year to about a million dollars. The largest single item concerns Washburn, where new machinery will be installed at a cost of more than $250,000. Other enterprises are new power lines from Washburn to Devil's Lake and from Velva, N. D., to Bergen and Voltaire, N. D. The company now distributes energy to 248 towns and is negotiating for plants in others.

AT WORK ON PLANS FOR KETTLE FALLS DEVELOPMENT.—Detailed plans for the development of the hydro-electric power site at Kettle Falls, on the Columbia River, 90 miles north of Spokane, Wash., are now being prepared by the engineering department of the Washington Water Power Company, according to V. H. Greisser, chief engineer. Surveys of the site have been under way since January, at which time the Columbia River is at low water. The company now has an application for license before the Federal Power Commission, which held a hearing in Spokane in February. The ultimate development at Kettle Falls will be for 260,000 hp., with an ultimate head of 75 ft. The first phase will probably embrace the development of the south channel between an island and the south bank of the river, where 35,000 hp. is available.

DETROIT INTENSELY LIGHTS ANOTHER BUSINESS SECTION.—Detroit became the possessor of one of the best-lighted business districts in the world when the new lighting system for downtown Woodward Avenue and adjacent streets was turned on recently. The equipment consists of two parallel rows of standards, 100 ft. apart on opposite sides of the street. On each are mounted two ornamental "Novalux" lighting units, manufactured by the General Electric Company. They are rippled glass, giving a maximum diffusion of light with a minimum of glare, and are equipped with 2,000-watt "Mazda" lamps. The installation includes 195 double standards. This is the second installation of intense lighting in Detroit. The Washington Boulevard installation includes larger units, using five 1,000-watt incondescent lamps per standard, but the standards are farther apart and the street is wider, so that the actual intensity of light is greater in the case of the Woodward Avenue installation.

LONG BEACH NO. 3 HAS UP-TO-THE-MINUTE CHEMICAL LABORATORY.—Long Beach steam plant No. 3 of the Southern California Edison Company embodies the very latest features of steam-plant engineering. One of these features consists of a completely equipped chemical laboratory not only

to carry on routine tasks connected with fuel, water and lubricants but also to do experimental work in the direction of further economies in operation. August Sattler is the chemist in charge.

ANOTHER DEVIL'S RIVER PERMIT GRANTED.—The Central Power & Light Company, through James C. Kennedy of Dallas, has obtained a permit from the State Board of Water Engineers for the use of not to exceed 550 sec.-ft. of water from Devil's River in Val Verde County for generating electric power. The dam will create a storage reservoir of 8,460 acre-feet of water. This will be the site of another of the series of hydro-electric plants that the company plans to build on the Devil's River.

NEW BRITISH COLUMBIA HYDRO PROJECT IN STRATHCONA PARK WOULD PRODUCE 90,000 HP.—Plans of the British Columbia Power Corporation for damming Buttles Lake in Strathcona Park and the two lakes below it and for the use of Campbell River have been announced at Victoria, B. C., by officials of the subsidiary Vancouver Island Power Corporation. The dam would be built at the outlet of the lake and 1,800 acres of land would be flooded. In addition the application asks for the right to dam both the lakes just outside Strathcona Park. On Lower Campbell Lake 3,500 acres of land would be flooded and on Upper Campbell Lake 3,700 acres. From a power plant on Campbell River, about a mile from its mouth, 85,000 hp. to 90,000 hp. would be derived. (See ELECTRICAL WORLD for February 23, page 413.)

BRILLIANT LIGHTING SCHEME FOR VICTORIA EMBANKMENT.—The London Council has decided on a comprehensive scheme for improving the lighting of the Victoria Embankment, which runs along the bank of the River Thames. The work will be done by the Charing Cross Electricity Supply Company in conjunction with the General Electric Company, Ltd., and the Pirelli-General Cable Works. A flood of light will be directed on to the road surface from lanterns suspended 30 ft. over the entire length of the road. The lanterns will be suspended in pairs from ornamental standards at 140-ft. intervals. Each lantern will contain a 1,500-watt gas-filled lamp.

PACIFIC GAS & ELECTRIC ANNOUNCES FURTHER ITEMS IN ITS 1929 PROGRAM.—The sum of $2,578,000 has been set aside by the Pacific Gas & Electric Company for this year's work on the Salt Springs hydro-electric development, a three-year program to be completed in 1931. The company reports also completion of a transformer station at Morgan Hill, from which the company will serve the Salinas Valley and the Monterey peninsula over a new transmission line and also supply the Coast Counties Gas & Electric Company in San Benito and Santa Cruz Counties. Power is delivered to the new station from Newark over a 110,000-volt line. It will be stepped down to 60,000 volts for delivery not only to the Coast Counties company but to a considerable area of P. G. & E. territory. The Newark line is being extended from Morgan Hill to Salinas and will represent, when completed, an investment of approximately $400,000. The extension will supplement the 110,000-volt line from Manteca to Salinas, built three years ago.

PROGRESS ON ALABAMA POWER UNDERTAKINGS.—Reconstruction of the Lower Tallassee hydro-electric development of the Alabama Power Company, which is scheduled for completion by July 31, 1930, is proceeding rapidly, excavation being more than half completed, concrete on the west abutment and the substation 94 per cent completed and 90 per cent or more of the powerhouse steel having been erected. Owing to the control over the river exercised by Martin Dam, very little flood damage has occurred. The foundation walls of the coming Mobile steam plant are about completed and the erection of structural steel is well advanced. As already reported, the company's new Gorgas steam plant will be ready in May. Construction on the 110-kv. feeder line into Mississippi, which traverses rough hill-and-valley territory for 33 miles out of Gorgas, then 18 miles of rolling land and then 33 miles to West Point over level country with swamps and the Tombigbee River to cross, is to be pushed rapidly as soon as the rains

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of every volume. For latest list see issue for January 5, page 80.]

Iowa Power and Industrial Conference —State University, Iowa City, April 2 and 3. C. C. Williams, dean.

Arizona Utilities Association—El Conquistador Hotel, Tucson, April 4-6. Lee C. McCullough, 134 South Central Ave., Phoenix.

Maryland Utilities Association—Emerson Hotel, Baltimore, April 12. D. E. Kinnear, 803 Court Square Bldg., Baltimore.

American Welding Society—Engineering Societies Bldg., New York, April 22-26. M. M. Kelly, 29 West 39th St., New York.

Middle West Division, N.E.L.A.—Hotel Fontenelle, Omaha, Neb., April 24-26. T. A. Browne, Lincoln, Neb.

Southwestern Division, N.E.L.A. — Arlington Hotel, Hot Springs, Ark., April 30-May 3. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

Southwestern Public Service Association—Hot Springs, Ark., April 30-May 3. E. N. Willis, 403 Slaughter Bldg., Dallas, Tex.

Arkansas Utilities Association — Arlington Hotel, Hot Springs, Ark., April 30-May 3. R. I. Brown, Arkansas Power & Light Co., Little Rock, Ark.

Indiana Electric Light Association — Hotel Gary, Gary, Ind., May 1-3. William Stokes, 1548 Consolidated Bldg., Indianapolis, Ind.

American Institute of Electrical Engineers—Regional meeting, Dallas, Tex., May 7-9. F. L. Hutchinson, 33 West 39th St., New York.

East Central Division, N.E.L.A. — Louisville, Ky., May 7-10. D. L. Gaskill, Greenville, Ohio.

Southeastern Division, N.E.L.A.—Asheville, N. C., May 8-10. C. M. Kilian, 207 Bona Allen Bldg., Atlanta.

National Electrical Manufacturers' Association — The Homestead, Hot Springs, Va., May 20-25. S. N. Clarkson, 420 Lexington Ave., New York.

American Electrochemical Society—Toronto, May 27-29. C. G. Fink, Columbia University, New York.

National Electrical Wholesalers' Association—The Homestead, Hot Springs, Va., May 27-31. E. Donald Tolles, 165 Broadway, New York.

National Electric Light Association—Atlantic City, N. J., June 3-7. A. J. Marshall, 420 Lexington Ave., New York.

are over. A 44-kv. line from Flomaton to Brewton, in the recently inundated territory in the southern end of the state, is also being built.

ENVISAGES LARGE TENNESSEE RIVER PROJECT WITH PLANT IN KENTUCKY.—Robert H. McNeill of Washington has applied to the Tennessee Public Utilities Commission for permission to construct a hydro-electric plant near Aurora, Ky., on the Tennessee River. The project would be developed by the Southern Industries and Utilities, Inc., of Maryland, which would have the backing of Eastern capital, Mr. McNeill is reported to have said. The dam would be in Kentucky, but most of the water would be impounded in Tennessee. The initial development contemplated would call for a 240,000-hp. plant, at a cost of $32,800,000, with the ultimate development of 528,000 hp. at a cost of $43,000,000. Water would be backed as far as Pickwick Landing, near the Alabama line, and the plant would be in position to serve western Tennessee and Kentucky and southern Illinois.

HYDRO - ELECTRICAL DEVELOPMENT LAGGED IN OREGON IN 1927 AND 1928.—That hydro-electric power was not so great a factor in the development of Oregon's water resources during the past two years as has been reported is indicated by the biennial report of the State Engineer. For 1,176 permits to appropriate water for power purposes in the state, the report, recently issued, shows only 845 certificates were issued. Had all of the projects for power development under the permits issued been completed, there would have been 35,811 hp. added to Oregon's hydro-electric production. The actual figure given is 1,038 hp. in addition to irrigation requirements applying to 20,769 acres.

Commission Rulings

RIGHT TO DEMAND DEPOSIT IS REFUSED TO LANDLORD.—A test case entered by W. G. Bauer of Haskell, N. J., before the New Jersey Board of Public Utility Commissioners on the demand of the Haskell Realty Corporation for a deposit of $5 for electric service in the house rented by him from the company was decided in his favor. The real estate company buys energy wholesale from the Jersey Central Power & Light Company and resells it at the same rate as that offered to homes by the power company. Mr. Bauer contended that he had lived seven years in his present house and had always paid his bills promptly. He insisted that the company was not justified in demanding a deposit.

DISCUSSION OF PROMOTIONAL RATES AND THEIR EFFECT.—Some general observations on the present-day method of promotional rates were made by the Alabama Public Service Commission in fixing rates to be applied in Mobile by the Alabama Power Company. The commission said in part as condensed in the *Public Utilities Fortnightly:* "The use for domestic electric consumers of block rates designed when lighting was the chief use of electricity is unlikely to encourage the larger use and rapidly growing demand of heavy-duty appliances in the small household. The commission in approving of a promotional rate to encourage use of household appliances based on the number of rooms in the average residence gives weight to the contention that such rate would increase the bills of consumers with large houses using very little energy and of a class least able to bear an increase in the cost of living. While consideration must be given to the fixed costs of serving each customer in fixing a minimum rate, as long as the utility is permitted to earn a fair return from its operations as a whole, the matter of the distribution of the service cost among its different consumers becomes of concern chiefly between such consumers. There are limits, under the law, and as a matter of equity between customers, beyond which the commission cannot reasonably go in the distribution of the cost of service among different classes of consumers. The larger homes should in justice pay a somewhat larger service charge than the small homes, provided that to each is offered the same opportunity of obtaining a low rate for additional energy consumed."

Recent Court Decisions

CONTRIBUTORY NEGLIGENCE OF ELECTRICIAN KILLED BY INTENTIONALLY TOUCHING WIRE IS FOR JURY'S DECISION.—In Platt vs. Cape Girardeau Bell Telephone Company and Missouri Utilities Company the St. Louis Court of Appeals held that it was bound by the verdict of the trial jury on the issue of contributory negligence, the jury finding that an inexperienced telephone electrician killed by touching a power wire after he had first observed it was not so guilty. Negligence of the power company was charged on the allegation that the insulation had been worn from this wire. (12 S.W. [2d] 933.)*

GRANT OF FLOWAGE RIGHTS NOT UPSET BY STATUTE OF LIMITATIONS.—The Supreme Court of Minnesota has found, in Pike Rapids Power Company vs. Schwintek, that a flowage contract entered into in 1910 is still valid and the defendants, who refused in 1925 to consummate the bargain after plaintiff had erected a dam and when the sum agreed upon as to be paid after the dam should have been built was tendered to them, could not shelter behind the statute of limitations. Increase in the value of the defendant's land since the contract was made did not render that contract inequitable, and adverse possession could not be established by occupancy and slight use of the land on the part of the contractor's successor. (223 N.W. 612.)

TOP OF FLASHBOARDS IS "CREST OF DAM" WITHIN REQUIREMENT THAT WATER BE ACTUALLY FLOWING OVER CREST. — In United Paper Board Company vs. Iroquois Pulp & Paper Company, the Court of Appeals of New York sustained the lower court by answering in the negative the following question: "Is it error, as a matter of law, to construe the words 'when the water of said river shall be actually flowing over the crest of the dam,' as contained in the reservation in the deed, to mean 'when the water of such river shall be actually flowing over the crest of the dam, including the flashboards not exceeding 18 in. in height as a part of the dam, the top of the flashboards to be taken as the crest of the dam when such flashboards are in place upon the dam'?" (164 N.E. 594.)

DESTRUCTION OF FACTORY SUPPLIED UNDER CONTRACT WITH ELECTRICITY DOES NOT ANNUL CONTRACT.—John Costaloupes and others composing a manufacturing firm made a contract with the San Joaquin Light & Power Corporation to supply power for their factory. Soon thereafter the factory was destroyed by fire and the firm, deciding not to rebuild, refused to pay the guarantee it had made for minimum consumption. The District Court of Appeal in California has sustained the San Joaquin company, which had expended considerable money in building a transmission line to the factory, in its suit to recover the sums due under the contract, which covered sale and delivery of electrical energy to the customer irrespective of its use. The measure of damages, the court held further, was not determined by the difference between the contract price of the energy and the proceeds from its resale. (274 Pac. 84.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

News About Men of the Industry

M. L. Hibbard New General Manager of Idaho Company

M. L. Hibbard, for the past year assistant general manager of the Idaho Power Company, Boise, has been named vice-president and general manager of that utility to succeed William R. Putnam, resigned. Mr. Hibbard has been identified with the Electric Bond & Share interests since 1928, when he severed his connection with the Northern States Power Company to affiliate himself with the Minnesota Power & Light Company, Duluth. He spent only four months there, at the expiration of that period having been transferred to Boise.

Following graduation from McGill University in 1906 he was connected with the General Electric Company in Pittsfield, Mass., the Montreal Street Railway Company and, after engaging in consulting engineering work for a short time, with the Union Light, Heat & Power Company of Fargo, N. D. Leaving Fargo early in 1910, he became engineer for the San Antonio Gas & Electric Company and the San Antonio Traction Company of San Antonio, Tex.

On July 1, 1911, he became general manager of the Union Light, Heat & Power Company of Fargo, N. D., which had been acquired by H. M. Byllesby & Company a short time before, but this property later became a part of the Northern States Power Company. In September, 1923, he was transferred to the general office of the Northern States Power Company of Minneapolis as assistant vice-president in charge of operation, continuing in this capacity until 1926, when he became chief operating engineer, the position he held until his association with the Electric Bond & Share Company.

H. A. Van Norman Heads Los Angeles Consolidated Bureaus

H. A. Van Norman, who was named chief engineer and general manager of the Municipal Department of Water and Power of the city of Los Angeles, formed by the consolidation of the water bureau and power bureau, as announced in the March 23 issue of the ELECTRICAL WORLD, has engaged in engineering work for the city since 1907. During the construction of the Los Angeles aqueduct he was divisional superintendent in charge of the construction of two divisions along the line of the great water carrier. Following the completion of the aqueduct he became aqueduct engineer in charge of operation and maintenance of the entire line from its intake in Owens Valley to Los Angeles.

In 1924 Mr. Van Norman was "borrowed" from the water bureau by the board of public works and was made engineer in charge of the construction of the new Los Angeles out-fall sewer line. He completed the construction of the sewer line, saving $5,000,000 out of the original estimate made by a board of engineers. In 1926 Mr. Van Norman was recalled to the water bureau and made assistant chief engineer and general manager to Mr. Mulholland. In that capacity he has been active during the past two years, with Mr. Mulholland, in engineering and survey work connected with the proposed Colorado River aqueduct. On the retirement of Mr. Mulholland December 1, 1928, Mr. Van Norman was made chief engineer and general manager to succeed him.

B. F. Cleaves Vice-President of Penn Central Company

B. F. Cleaves, general superintendent of electric operations of the Penn Central Light & Power Company, Altoona, Pa., has been advanced to the position of vice-president. Mr. Cleaves is well qualified to assume these new executive duties, having had considerable practical business experience as well as technical training. Following graduation from the Lowell Institute of Boston he worked with the General Electric Company and the Westinghouse Electric & Manufacturing Company, serving his apprenticeship in electrical work with these companies. In 1911 he entered the employ of the Penn Central Light & Power Company as engineer of tests. After a period of five years he was advanced to the position of electrical engineer, holding this position until 1926, at which time he was promoted to the position of general superintendent of electric operations. In January, 1928, he was appointed chief engineer for the Municipal Service Company properties in Pennsylvania. Mr. Cleaves is a member of the American Institute of Electrical Engineers and is actively affiliated with various committees of the National Electric Light Association and the Pennsylvania Electric Association.

W. H. Wade Assumes New Executive Duties in Altoona

W. H. Wade, who has been connected essentially with the commercial activities of the Penn Central Light & Power Company, has just been appointed assistant to the president. His first connection in the public utility field following graduation from the University of Pennsylvania was with Day & Zimmermann, Inc., in Philadelphia and later he was transferred to the Penn Central Light & Power Company as power engineer. In three years he was advanced to the position of new-business manager in charge of the sale of electric power and light, merchandise sales and rates, which position he held until January 1, 1928, when in addition to his duties as new-business manager he was appointed to the position of assistant to the vice-president of the Municipal Service Company, controlling the Keystone Public Service Company, the Edison Light & Power Company and the Chester Valley Electric Company. He will continue to function as assistant to the vice-president of the Municipal Service Company. Mr. Wade is a director of the Penn Central Light & Power Company, Municipal Service Company, Keystone Public Service Company, Edison Light & Power Company, Chester Valley Electric Company, Altoona & Logan Valley Electric Railway Company and other subsidiary companies under the control of the Municipal Service Company. He is a past-chairman of the Commercial Section of the Eastern Geographic Division of the National Electric Light Association, having been chairman of all subcommittees of that section. He is at the present time a member of the executive committee of the Pennsylvania Electric Association and chairman of the rate committee of the Eastern Geographic Division of the National Electric Light Association.

D. W. SNYDER, JR., formerly vice-president of the Illinois Terminal Railroad System with headquarters in Springfield, has been appointed president of the Missouri Power & Light Company with headquarters in Kansas City.

LOUIS RUTHENBURG has been appointed president and general manager of Copeland Products, Inc., Detroit, according to an announcement made by William R. Wilson, chairman of the board. Mr. Ruthenburg joins Copeland Products after severing his connection with General Motors interests.

Foshay Company Makes New Appointments

L. L. Hill, vice-president of W. B. Foshay Company and long a resident of Minneapolis, has been made general manager after a connection with the company of a little more than six months. It was last fall that Mr. Hill of the Page & Hill Company, Minneapolis, joined the Foshay organization. His new duties will bring him in contact with every department of the company and into the territory served by public utility and industrial divisions.

Another promotion in the Foshay ranks is that of O. M. Spratt. Mr. Spratt, who rejoined the W. B. Foshay Company a year ago as assistant to the president, was elected vice-president of the company at a recent directors' meeting. Mr. Spratt removed to Minneapolis from Kansas, where he had been for fifteen years at the head of his own insurance company. He is now president of the insurance company known as the O. M. Spratt Corporation.

J. F. Lincoln Named President of Lincoln Electric Company

J. F. Lincoln, formerly vice-president of the Lincoln Electric Company, Cleveland, Ohio, has been elected president of the company to succeed J. C. Lincoln, who has been elevated to the position of chairman of the board of directors. Since 1912, when he became general manager of the company, J. F. Lincoln has been an outstanding figure in the electrical industry. He was among the first to envision the enormous potentialities of electric arc welding as a manufacturing tool as contrasted with a process for salvage and repair.

So certain was Mr. Lincoln that arc-welded steel construction would supersede other methods of manufacturing machine parts that he insisted on redesigning the complete line of motors and welders manufactured by the company, to utilize this process. This was at a time when many manufacturers were still speculating on the strength and dependability of welds made by the arc process.

The new duties assigned to J. C. Lincoln will afford him additional time to devote to electrical research.

Obituary

Valère A. Fynn

Valère A. Fynn, nationally known as consulting engineer and inventor, died of blood poisoning at St. Luke's Hospital, St. Louis, Mo., March 20. He was 58 years of age. Mr. Fynn had come to be recognized as an authority on patent matters, having had to his credit 300 patents in nine different countries. He was called upon to appraise the technical, commercial and patent value of designs and to serve patent attorneys in helping them frame specifications and claims in difficult cases and in giving expert advice in patent litigation. Perhaps his greatest achievement was his contribution to the development of the single-phase motor and to other inventions relating to motors, among which is the Fynn-Weichsel motor. The solution of the problem of speed regulation of single-phase motors he published in 1905, and this he followed by a long series of inventions in this field, the development of a number of new motors and the improvement of existing types.

Born in Russia when his father, an Irishman by birth, was building imperial railroads, Mr. Fynn received his technical education at the Swiss Federal Polytechnic in Zurich. His early practical engineering experience he obtained with Brown, Boveri & Company in Switzerland and with Easton, Anderson & Golden in London, and subsequently he established offices in London as a consulting engineer. His single-phase motors were manufactured by the Elektricitäts-Gesellschaft Alioth of Switzerland, France, Germany, Italy and Spain and the General Electric Company of England. In 1909 he transferred his interests to the United States, and from that year until 1921 he was retained by the Wagner Electric Manufacturing Company as consulting engineer. The Wagner Electric took out licenses under almost all of his numerous patents and during the twelve years this connection lasted Mr. Fynn gave his undivided attention to it. Since 1921 he has engaged in independent consulting engineering work with offices in St. Louis. Mr. Fynn was a fellow of the American Institute of Electrical Engineers and a member of the Institution of Electrical Engineers (Great Britain).

T. H. Blakesley, a leading British expert on electrical and physical matters, died in London, England, February 13 at the age of 81. For many years he was honorary secretary of the British Physical Society. His most important work was connected with the science and practice of the accurate measurement of alternating currents. Mr. Blakesley also made valuable contributions to the theory of the transmission of power, telephony through long cables and the application of hyperbolic functions to electrical problems.

Dr. Ludwig Kohlfurst, a well-known Austrian authority on railway electrification and telegraphy, died recently at Kaplitz, Bohemia, at the age of 89.

Thomas S. Henderson, for twenty years sales manager of the West Penn Power Company, died, after a brief illness, at his home in Overbrook. Mr. Henderson was born at Newcastle-on-Tyne, England, and removed to McKeesport with his parents when a lad. After studying music he returned to his native land, where he served for several years as a dramatic critic. He returned to western Pennsylvania, where he joined the West Penn Power Company in 1903, becoming sales manager in 1909. Mr. Henderson was a member of the Pittsburgh Chamber of Commerce and the Springdale Chamber of Commerce.

Robert L. Warner, for the past 22 years prominent in the investment banking business at Boston, Mass., died at his home in that city March 25. He was born at Kansas City 59 years ago, and after graduating in mechanical engineering from Cornell University in 1892 he became associated with the Westinghouse Electric & Manufacturing Company, ultimately becoming manager of the New England sales office with headquarters at Boston. Later he became a partner in the banking house of Warner, Tucker & Company and for some time was largely interested in the North American Company.

Charles L. Kurtz, formerly president of the Columbus Railway, Power & Light Company, Columbus, Ohio, died at his home in that city on March 24. Mr. Kurtz returned recently from Mexico, seriously ill after a month's business trip. When in January, 1925, he resigned as the president of the Columbus Railway, Power & Light Company he ended a period in his career of outstanding achievement in the field of public utility management. Early in life Mr. Kurtz was interested in politics, having been a state legislator, private secretary to an Ohio Governor and a power in the Republican party. After abandoning politics for business he became identified with many commercial undertakings and at the time of his death he was president of the Keever Starch Company of Columbus, president of the Guanajuato Reduction Company, engaged in mining in Mexico, and president of the Scioto Stone Company, Columbus. He was 74 years of age.

Financial and Statistical News

——This week's drastic market liquidation, which accompanied 20 per cent money and set up a single day's trading total 1,292,720 shares over the previous record, affected all classes of stocks, the seasoned issues as well as the new.

——It is significant, however, to those who preach the stability of the utility industry that no other single group of stocks withstood the selling orgy as did the power and light issues. Of the stocks on the New York exchanges, only one declined more than ten points in the two sessions of heaviest liquidation. Few, in fact, lost more than five points. American & Foreign Power declined 16 points in two days. American Superpower B declined 8¼ points and National Power & Light 7⅜ points during the same period. Detroit Edison lost 7 points the first of the two selling days, but gained 2¼ in the session of heaviest selling. Columbia Gas & Electric sold off 7½ points in the two days.

——It may or may not be significant that this drastic selling movement falls within the last week of March. Month-end requirements will be heavy, but there seems to be a fairly general sentiment that, as the first quarter of the year closes—March going out like a lion, so to speak—the air is much clearer than it was.

——It seems generally regarded in financial circles that a rise in the Federal Reserve rate is now farther away and that the opponents of the bull movement are temporarily satisfied with developments.

Utility Profits 18.7 per Cent Over 1927

A group of 120 leading public utility companies showed a gain in net profits of 18.7 per cent over 1927 and of 32.75 per cent over 1926, according to a compilation prepared by Ernst & Ernst, from published financial statements. The total number of companies studied were 1,042 in all industries, and it was found that net profits showed an aggregate of 17.19 per cent over 1927 and of 11.35 per cent over 1926.

For 815 industrials, the compilation shows an aggregate increase in earnings over 1927 of 20.49 per cent, for 82 railroads of 9.9 per cent and for 25 financial institutions of 70.36 per cent. In the public utility group 92 companies out of 120 showed gains over 1927 and 28 showed losses.

Ontario Power Commission Issues Annual Report

The annual report of the Ontario Hydro-Electric Power Commission for the year ended October 31, 1928, shows a net surplus of $940,663. Increases in practically every branch of the commission, including investment, reserves, amount of power supplied and number of consumers, are shown in the report.

From municipal utilities and other consumers, for power sold, the commission collected $24,287,296. Expenditures amounted to $23,346,633. This sum was appropriated to meet all fixed charges and reserves and to provide for the expense of operation and administration. Investment in plants and assets is now over $300,000,000, as compared with $88,000,000 in 1918. A table of distribution of power to eight systems shows a total of 1,032,500 hp., as compared with 949,700 for the year ended in 1927. The Niagara system, including exports, shows the largest distribution, 879,357 hp. As late as 1925 the annual increase in reserves was about $3,500,000. Last year the increase was $6,300,000 after the commission had paid to the province $1,600,000 out of reserves.

International Paper Launches Utility Holding Company

To acquire control of the two leading utility organizations identified with the International Paper & Power Company, a new holding company has been formed under the name of International Hydro-Electric system. The new organization is a Massachusetts voluntary association and will own directly 82 per cent of the outstanding common stock of the New England Power Association and the entire common and second preferred stocks of Canada Hydro-Electric Corporation, Ltd. The combination forms one of the largest groups of hydro-electric properties in the world.

In connection with the transaction a New York banking group has underwritten an issue of $30,000,000 6 per cent debentures. Proceeds of this issue will be applied partly on the payment for certain shares of New England Power Association, which it will acquire. Total shares of that association, which the system will acquire in this manner and otherwise, represent a value, based on present market quotations, of over $70,000,000. Large additional values are represented by the second preferred and common stocks of Canada Hydro-Electric Corporation, Ltd.

The physical properties in the system, upon completion of the present financing program, will include hydro-electric generating stations with a total capacity, installed or under construction, of over 1,037,000 hp., of which 787,100 hp is now in operation. This capacity can readily be increased to over 1,800,000 hp. In addition to these hydro-electric properties, the system includes steam-electric plants with a present installed capacity of 382,000 hp. For 1928 total output of these operating properties was 2,733,451,000 kw.-hr. It is estimated that output will reach 3,650,000,000 kw.-hr. in 1929.

Electric Bond & Share Issues New Preferred Shares

The new Electric Bond & Share Company offered during the past week 250,000 shares of cumulative $6 preferred stock at $106 per share and accrued dividends, to yield 5.66 per cent. Proceeds will be used for expansion of the business. After giving effect to the consolidation and following the completion of this financing Electric Bond & Share will have outstanding 750,000 shares of $6 preferred stock and 9,615,306 shares of common stock. It has no mortgage or funded debt.

How Many People in Electrical Industry?

About 1,000,000 people are now engaged in the various branches of electrical industry in the United States, according to an estimate made jointly by the ELECTRICAL WORLD and *Electrical Merchandising*. The distribution is:

Electric light and power companies	290,000
Electrical manufacturing	250,000
Electrical retailing	150,000
Electrical contracting	200,000
Electrical jobbing or wholesaling	50,000
Miscellaneous	10,000
Total	950,000

The estimate is probably conservative. On some of the items no statistics of employment seem ever to have been collected. On others the latest definite figures are several years old and required revision in view of the subsequent strides of the industry.

To the preceding list might be added the employees connected with the electrical side of street railway and electrified railroad operation, as well as an unknown number of men engaged in the maintenance and operation of more than 2,500,000 factory motors with an aggregate rating of some 28,000,000

hp., industrial power plants exceeding 7,000,000 kw. and, in addition, private plants not connected with manufacturing establishments. Their inclusion would bring the total well over a million persons.

All this is only in the field of power engineering. The inclusion of electric communication would add 400,000 for telephony alone and another 75,000 for telegraph and cable systems. As for the radio, who shall define that hazy line where the mere employee merges into that higher caste which includes the "guest announcer?" Broadcasting must use 3,000 to 4,000 technical men.

Southern California Edison Enters Upon Commercial Era

IN THE annual report of the Southern California Edison Company for the year 1928 John B. Miller, chairman of the board of directors, announces that the company entered upon a new era with the beginning of the last fiscal year. "The 'commercial era,' which had its inception with the year under review," he says, "marks a new cycle in the evolution of your company. During the past two decades we were primarily engaged with a comprehensive development of water-power production and the general financing thereof. Your company's greater hydro-electric development has arrived at the stage of completion in all of its major aspects. Marking the transition to a predominantly steam-electric system, our major steam plant development under construction during the past several years has progressed to that stage of completion as to ultimate design and construction where the addition of further power capacities, as load conditions dictate, can be effected in minimum time and is merely a matter of unit installation under a fixed and definite schedule. . . . With these major activities in the background, your company enters upon a period of intensive load building and distribution. During the ensuing five years the largest proportion of annual capital expenditures will be allocated to building new business, and this means larger revenues, reduced rates and greater net profits."

Gross earnings for the year amounted to $35,281,927 as compared with $30,600,637, an increase of $4,681,290. This increase was established in spite of the fact that on July 1, 1927, the company put into effect a general reduction in its lighting rates, the result of which is reflected in the comparative earnings for the first six months of 1928. Net earnings after taxes, before interest, depreciation and dividends, totaled $23,486,981, an increase of 13.9 per cent. The earnings per share ($3.10) on the common stock for the year 1928 showed a slight decline due to the large amount of new property brought into operation this year. This included 254,600 hp. additional plant capacity, an increase of 31 per cent.

Capital expenditures, including construction, plant additions, extension to the transmission and distribution systems during the year totaled $25,795,697 and the directors have authorized a budget of $24,160,214 for capital expenditures during 1929. Total assets of the company have grown from $100,457,000 in 1919 to $336,817,000 in 1928, an increase of $26,978,719 being recorded for the year 1928 alone. Cash proceeds from capital stock sales for the year and collections on maturing contracts amounted to $22,441,838 and were used to finance, in part, capital expenditures for additions and betterments to properties. During the year 4,096 new stockholders were added and on December 31 they numbered 118,246, with average individual holdings of 57.4 shares each.

The total system output in 1928 amounted to 2,762,459,843 kw.-hr., as compared with 2,421,357,098 kw.-hr. in 1927. It is interesting to note in this connection that the output from the water-power plants dropped from 2,168,339,108 kw.-hr. in 1927 to 2,069,979,993 kw.-hr. in 1928, while steam plants advanced from 241,530,190 kw.-hr. in 1927 to 658,709,170 kw.-hr. in 1928. Out of this output 10.9 per cent was absorbed in lighting service while 88.7 per cent was absorbed in power service. The total operating capacity of the company's plants at the close of the year aggregated 1,072,760 hp., of which 588,360 hp. is hydro-electric and 484,400 hp. is steam-electric. In 1928 a total of 292,719 hp. in new business was contracted. This is the largest single year's business in the history of the company and represents an increase of 42 per cent over the year preceding. During the current year a quota of 358,000 hp. in new business has been assigned and is actively under way.

The company sold to its commercial department 5,200 ranges, 465 refrigerators, 1,435 water heaters, 1,735 washing machines, 1,900 vacuum cleaners and 23,000 smaller appliances. The extensive use of this equipment has contributed substantially to the increase in the average consumption per residential customer. This figure has increased from 428 kw.-hr. in 1924 to 572 kw.-hr. in 1928, an increase of over 33 per cent; 34,947 new customers were connected to the lines during the year, and the company now serves directly 414,415 customers and indirectly 325,000 customers.

System lines and territory served by Southern California Edison

In summing up the accomplishments of the year the report includes among the outstanding results the completion of 120,600 hp. additional hydro-electric and 134,000 hp. steam-electric generating capacities; reduction of operating expenses through improvement in steam plant economies; forthcoming reductions in rates for agriculturists and street lighting; absorption of three independent utility systems, one of which was municipally owned; adjustment of a series of long-drawn-out controversies with the Los Angeles Municipal Electric Bureau; settlement of practically all riparian ownership claims of many years' standing affecting Big Creek water storage; retirement of 5½ per cent bonds of 1944 amounting to $10,225,000 and the financing of the year's capital requirements through the sale of 5½ per cent preferred stock. The report says:

"In entering upon 1929 we are stepping forward into a greater commercial era for the Pacific Southwest. The progress of your company, which is a

	1924	1925	1926	1927	1928
Gross earnings	$21,390,000	$24,832,000	$27,846,000	$30,600,000	$35,282,000
Net earnings	8,396,000	16,561,000	18,062,000	20,616,000	23,487,000
Balance for dividends and surplus	3,019,000	7,340,000	8,859,000	11,060,000	13,168,000

Current Earnings Reports of Electric Light and Power Companies

	1929	1928	Per Cent Increase	Operating Ratio 1929	Operating Ratio 1928
American Water Works & Electric & Subs. (Year ended Jan. 31)					
Gross earnings	$51,245,203	$48,866,582	4.9	51	53
Net earnings	25,183,285	22,892,047	10.0	..	..
Blackstone Valley Gas & Elec. & Subs. (Year ended Jan. 31)					
Gross earnings	6,132,321	5,914,838	3.7	..	..
Net earnings	2,434,218	2,144,144	13.1	..	..
Cities Service (Year ended Jan. 31)					
Gross earnings	35,242,133	32,850,842	7.3	..	..
Net earnings	34,076,346	31,739,718	7.3	..	..
Commonwealth Power & Subs. (Year ended Jan. 31)					
Gross earnings	59,026,966	53,550,307	10.3	51	53
Net earnings	28,727,872	24,976,572	15.0	..	..
Consumers Power (Year ended Jan. 31)					
Gross earnings	30,821,343	26,913,469	14.5	49	51
Net earnings	15,628,940	13,090,201	19.4	..	..
Detroit Edison & Subs. (Year ended Jan. 31)					
Gross earnings	52,978,803	47,658,276	11.2	65	68
Net earnings	18,494,856	15,437,908	19.8	..	..
Eastern Texas Electric & Subs. (Year ended Jan. 31)					
Gross earnings	8,133,440	7,278,115	11.8	..	..
Net earnings	3,324,868	2,641,594	25.8	..	..

	1929	1928	Per Cent Increase	Operating Ratio 1929	Operating Ratio 1928
Engineers Pub. Service & Subs. (Year ended Jan. 31)					
Gross earnings	34,512,713	29,637,855	16.5	58	61
Net earnings	14,549,155	11,485,213	26.7	..	..
General Gas & Electric & Subs. (Year ended Jan. 31)					
Gross earnings	23,676,720	24,285,401	—2.5	52	55
Net earnings	11,469,223	11,063,195	3.7	..	..
Kansas City Power & Light (Year ended Jan. 31)					
Gross earnings	13,830,178	12,671,477	9.1	51	51
Net earnings	6,772,848	6,293,337	7.6	..	..
Penn-Ohio Edison / Northern Ohio Power (Year ended Jan. 31)					
Gross earnings	27,899,522	26,450,429	5.5	60	64
Net earnings	11,129,861	9,547,935	16.6	..	..
Portland Electric Power (Year ended Jan. 31)					
Gross earnings	12,563,860	12,178,991	3.2	60	60
Net earnings	5,071,112	4,978,913	1.9	..	..
Puget Sound Power & Light & Subs. (Year ended Jan. 31)					
Gross earnings	15,247,323	14,940,655	2.0	..	..
Net earnings	6,626,872	6,391,296	3.7	..	..
Tennessee Electric Power (Year ended Jan. 31)					
Gross earnings	13,517,450	12,585,890	7.4	52	55
Net earnings	6,543,916	5,757,234	13.7	..	..

reflection of the progress of southern and central California, pictures the stages by which the development has come. Like your company, the Southwest has built a strong financial foundation and has developed the machinery to carry on the job ahead."

Sloan Discusses Utilities as Agencies of Social Welfare

"A starved utility is the worst possible servant a community can keep, a drag on the progress and welfare of the city and its people," Matthew S. Sloan, president of the New York Edison Company and the companies associated with it in Greater New York, declared in a recent address before the Finance Forum of the School of Finance of New York University. Pointing out that utilities are not only businesses, he said that "to a much greater degree than is true of most other concerns utilities are also agencies of social welfare.

"Only a prosperous utility can do its job satisfactorily to the public requiring service," he continued. "A nice balance of all elements of cost of operation, managerial policies and revenue received is necessary, therefore, both on the part of the utility and the regulating body, in order to make possible prosperity sufficient to attract the constant flow of new capital required and still not permit the utility to profiteer by unduly high prices.

"There is considerable divergence of opinion about the effectiveness and value of regulation. Some people contend that it has broken down. Some assert that it operates only to the benefit of the public service companies. I don't subscribe to that view. We of the utilities believe that their remarkable development in recent years has been due in considerable measure to public regulation. Nothing hampers the growth of business like uncertainty. Regulation has brought the element of stability into utility operation. Under it we know pretty well what we may do and what we may not do.

"The chief problem of the utilities under regulation is to make and keep themselves sufficiently prosperous to attract new capital, which is constantly required for extending and bettering their service. This is not alone a problem for the utility. It is also a problem for the public requiring service and for the regulating body representing the public interest. The electric utility is a basic element in the community. Factories and stores depend on its service as do public buildings, municipal services, such as street lighting, traffic control, police and fire alarm systems and transportation systems in part or wholly. Homes depend on it. More and more it has come to be a valuable and important social agency."

After commenting at some length on the function of the holding company, more properly known as investment and managing companies, according to Mr. Sloan, he closed his address with a discussion of the relation between water power and steam power as to generation, transmission and distribution costs and future possibilities.

4,000,000,000 Kw.-Hr. in New York City

More than 4,000,000,000 kw.-hr. was generated by the five electric utilities serving the metropolitan district of New York City in 1928, according to a statement by Matthew S. Sloan, president of the New York Edison and affiliated companies. This is a new high record and is more than a fourth of the entire state output last year, estimated at approximately 15,000,000,000 kw.-hr. The peak came at 5 p.m. on December 20, with 1,146,128 kw. The previous record was that of December 13, 1927, at 5 p.m., 1,037,000 kw.

Electricity in Java

A recent report published by the Department of Water Power and Electricity of the Dutch East Indies, with headquarters in Bandoeng, Java, states that the active electrification noted in 1926 continued during 1927. The number of small communities receiving electric service again increased. Small establishments were absorbed in large organizations, thus insuring their future development.

Both the Mendalan water-power plant in East Java and the Kratjak (13,000 kva.) in West Java, the latter a government undertaking, were at the time of writing the Report expected to go into operation about the middle of 1928.

By agreement with one of the private operating companies 160 km. (100 miles) of 30,000-volt line is to be built to serve new territory. The government will build three of the 30,000/6,000-volt substations required and the private company (G.E.B.E.O.) one. The financial soundness of the extensions is guaranteed by the advance contracts in the territory to be opened.

Government operations in Java are carried on in two independent divisions which it is proposed eventually to connect: The western, including Batavia, and one farther east on the island, around Bandoeng. The former, at the end of 1927, had a book value of 9,927,681 florins, output during the year of 25,669,980 kw.-hr., of which 8.1 per cent was lost in transmission, and an annual load factor of 45 per cent. Corresponding figures for the other divisions are: 11,558,390 florins, 31,544,450 kw.-hr., 3.9 per cent, and 55 per cent. Over a third of this latter output was used for radio, chiefly at Malabar, communicating directly with Holland.

Known water-power sites on the island amount to 810,390 hp. on the basis of minimum flow during 350 days. Only a small fraction of this has been developed.

Business News and Market Conditions

Copper Cannot Remain at 24-Cent Level

RAPID advances in the price of copper, lead and zinc during recent weeks have created a furor in the metal market and in the industries using these metals. Consumers are insistent in their demands and the producers are human enough to take advantage of a situation that is largely psychological.

There is little doubt that a 24-cent copper price cannot be maintained unless there is complete control of copper production. Enormous deposits of copper are available in different parts of the world and many new producers are entering the field. American engineers are now busy putting in plants in Great Britain, Africa and Belgium and within a few months the world's production will be up to about 2,000,000 tons a year. A 24-cent copper price offers sufficient profit margin to stimulate production enormously and by July 1 copper prices should reflect the increased production.

The present copper situation is a development that could have been anticipated. After the war the low prices and the large stocks on hand caused the copper interests to move in two directions. One was to expand the markets for copper through extending its uses into a greater variety of applications and an outstanding marketing research and sales promotion effort was extremely successful. A simultaneous move was toward a unification of copper producers to secure some control of the rate of copper production and many mergers and consolidations have resulted. These two movements, together with the adoption of the hand-to-mouth buying principally by consumers, developed into the present copper market conditions. The demand for copper is so great that the market price has advanced to unanticipated heights, but the famine is largely a state of mind of copper buyers and a sane study of the situation leads to the conclusion that within a few months at most the price of copper will decline. There is plenty of copper in the world and, even though copper is not profitable to producers at a price much lower than 15 cents, the 24-cent level offers profit margins that may react to make for over-production. The copper pendulum swings too far and is difficult to control, but the mean copper price will adjust itself to the normal economics of supply and demand.

Record Manufacturing Operations

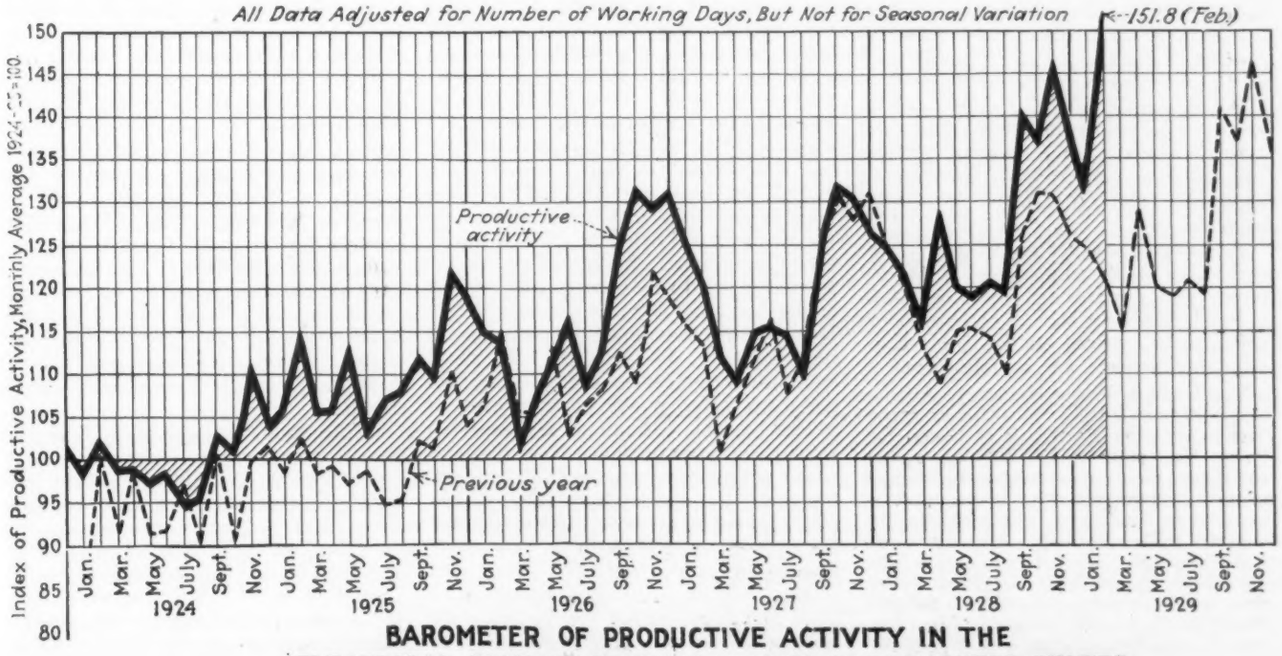
Electrical Manufacturing Plants Report New High Rates of Activity During February—Unusual Advance for this Season of the Year

REPORTS received by the ELECTRICAL WORLD from a large proportion of the electrical manufacturing plants of the country indicate that a new record for rate of productive activity was hung up by the industry during the month of February. The February rate of operations were 15.6 per cent over January, 24.6 per cent above February last year and 3.7 per cent above the previous high rate of operations recorded in November last year. This is the first time since 1925 that an increased rate of operations was recorded in February as compared with the previous January. In 1926, 1927 and 1928 the downward trend in rate of activity which usually starts in November was continued through March. The current year is evidently experiencing an impulse in the demand for electrical apparatus and equipment which was not recorded during the past three years.

February, 1929	151.8
January, 1929	131.3
December, 1928	135.3
November, 1928	146.4
February, 1928	121.8
Average first two months 1929	141.6
Average first two months 1928	123.3

The upward turn in rate of operations was reported by both the large and small electrical manufacturing plants. The larger companies recorded an average increase in operations of 21.3 per cent as compared with January and 33.4 per cent as compared with February last year. The smaller plants reported an increase of 12.4 per cent over January and 20.4 per cent over February last year.

The index of activity in the electrical manufacturing industry, based upon consumption of electrical energy, stands at 151.8 for February as compared with 121.8 in February last year. Comparative indexes of productive activity referred to the average activity for the period 1923-25 as 100 and adjusted for number of working days are as shown in the accompanying table.



BAROMETER OF PRODUCTIVE ACTIVITY IN THE ELECTRICAL MANUFACTURING PLANTS OF THE UNITED STATES

Market Conditions

——The first quarter of 1929 was a record quarter in the electrical equipment industry, according to an estimate based on data received from all sections of the country. Volume of business continues at a high level and the outlook for the second quarter is decidedly favorable.

——In the East business in fractional-horsepower motors has eased off somewhat. Refrigeration equipment producers are responsible for some good orders. In New England small equipment business is quite good.

——The utilities in the Middle West are busy with spring construction and day-to-day business is very satisfactory in volume. In the St. Louis area sales of medium-sized motors for attachment to pumps, ice machines etc., are unusually heavy.

——In the West Coast area demand for 20 and 25-hp. irrigation motors is stated to have strained stocks to the limit. Both central-station and industrial buying is heavy on the North Pacific.

Many Equipment Orders Reported in Southeast

Very satisfactory activities were noticeable in the central-station and industrial fields in the Southeast and good orders are coming through, with still a considerable amount in prospect. One of the larger power companies' distribution and small power transformer orders aggregated $88,000, while one of the smaller companies bought substation equipment totaling $8,000. One manufacturer reports the receipt of two orders, one from Florida and the other from Georgia, for carrier-current equipment, each order approximating $7,500. Some other central-station orders were for switching equipment amounting to $5,800 and creosoted pine poles costing $2,100. A tire fabric manufacturing plant in Georgia bought six 1,000-kva. transformers and will within the next couple of weeks order motor equipment and accessories aggregating $150,000. Substation equipment totaling $65,000 was ordered for a railroad electrification project in the Carolinas. A textile mill in South Carolina ordered $35,000 in motor equipment, while a cotton mill in North Carolina ordered conduit and safety switches amounting to $20,000 and will this coming week purchase an additional $80,000 worth of wiring supplies.

A contract was let on a textile electrification in Mississippi and $9,000 in motor and switchboard equipment was ordered. Wiring materials costing $6,000 will also be ordered on this job. Construction projects are as follows:

The Georgia Power Company, Atlanta, Ga., will construct a 110,000-volt transmission line from Porterdale to Macon, Ga. Paris, Va., plans a floodlighting system and beacon lamps at its proposed municipal airport. Elkins, W. Va., plans improvements in its light and power system to cost $100,000. The Kentucky Utilities Company, Louisville, Ky., plans a power substation at Morganfield, Ky., and extensions in transmission lines, to cost $75,000. The Full Fashioned Hosiery Mills, Inc., Chattanooga, Tenn., plans a mill at Nashville, Tenn., to cost $150,000. The Seaboard Air Line Railway Company, Savannah, Ga., plans a power plant at Monroe, N. C., to cost $40,000. The Greenville Cotton Mills, Greenville, N. C., plans an addition to cost $115,000. The Tide Water Power Company, Wilmington, N. C., plans a transmission line to Kinston, N. C., and vicinity, to cost $70,000. The Fairforest Finishing Company, Spartanburg, S. C., plans a bleachery and silk finishing plant to cost $800,000. Jackson, Miss., plans a municipal fire alarm system to cost $50,000.

The Georgia Power Company, Atlanta, Ga., plans a steam-operated electric generating plant on the Chattahoochee River, near Atlanta, with capacity of 100,000 hp., to cost $3,000,000. Clearwater, Fla., plans an ornamental lighting system. Point Washington, Fla., plans a floodlighting system and beacon lamps at its proposed municipal airport.

Steady Buying Prevails in New England

Small orders in good volume prevail in the New England district and a number of substation equipment orders have been recently placed. Power equipment orders are confined to small motors and inquiries continue concerning motor-generating units and turbo-generators. Reports of a number of small substation equipment orders have recently come in, one for insulators, bus supports and control amounting to about $3,000 and another consisting of similar equipment for about $2,000 being noted. In southern New England an order for an insulated board to be used in an addition amounting to $8,000 was recently placed. New control equipment, consisting of high-voltage disconnecting switches amounting to $53,000 was recently ordered for a new power plant in western Massachusetts. Aluminum transmission cable for a large northern New England power development was recently ordered, the order for special high-voltage control equipment for this line having recently been placed with a prominent manufacturer.

Negotiations for heavy equipment continue and inquiries for new projects are coming in, while scheduled material sales are in good volume and merchandising sales are steady. Construction projects are as follows:

The Public Electric Light Company, St. Albans, Vt., will add another unit to its development on the Lamoille River. The Moore Drop Forging Co., Springfield, Mass., plans a switching station. The Norton Company, Worcester, Mass., plans an addition to its refractory plant to cost $100,000.

Industrial Demand Active in Eastern District

Industrial account shows an upward trend in the Eastern district and both commitments and inquiries are developing broad proportions. A manufacturer of air compressors in New Jersey has ordered a motor-generator set, switching and auxiliary equipment to cost $75,000. A maker of aircraft motors in the same state has placed a commitment for supercharger impellers to an amount of $120,000. A producer of industrial motors says that the bulk of call is centered in units around 15 hp. capacity. Fractional-horsepower motors are showing a tendency to ease off a little, with refrigerating equipment manufacturers placing heavier orders than evidenced in other lines. A manufacturer of talking machines in the East has ordered a quantity of fractional-horsepower induction disk type units to the sum of $50,000.

Central-station demand shows no change. Utility companies are making sizable purchases of equipment of various kinds and there is no present indication of let-up. A feature of the week's development is the announcement of the budget of the New York Edison Company for 1929 expansion and betterments, totaling $68,700,000, of which approximately $20,000,000 will be expended for power plant account, $40,500,000 for transmission and distributing lines, including $17,500,000 for underground conduit installations, and the remainder for substations and miscellaneous construction. There is a strong call for switching apparatus, oil circuit breakers, regulators and kindred equipment. A northern New York power company has contracted for a quantity of switching apparatus, including lightning arresters, to cost $100,000 and a central station in southern New Jersey has purchased similar equipment to an amount of $20,000. Another power interest in New Jersey has given a commitment for oil circuit breakers approximating $300,000 and a central station in western Pennsylvania has ordered regulating units to a sum of $40,000. A municipality in Pennsylvania has placed a contract for two Diesel engine-generating sets for a municipal lighting station.

While good business prevails in the line of transformers, recent price advance, due to the higher cost of raw materials, is tending to ease accounts in this line. A New York manufacturer has taken an order from a central station in Virginia for equipment of this kind to cost $100,000. Another commitment has been received from a metropolitan power company running to $115,000, while a Tennessee utility has

purchased transformers to the sum of $30,000. A maker of electric lamps in New Jersey reports heavy sales and airport account is advancing rapidly. Construction projects are as follows:

The Prudential Oil Company, New York, plans extensions in its storage and distributing plant at Richmond, Va., to cost $400,000. The Arrowhead Steel Products Company, Buffalo, N. Y., plans a plant to cost $100,000. The Roosevelt Field, Inc., New York, will build an airport at Westbury, L. I., and buildings, floodlighting system and beacon lamps, to cost $2,500,000. The American Brake Shoe & Foundry Company, New York, plans a plant at Los Angeles, Calif., to cost $125,000. The Westchester Lighting Company, Mount Vernon, N. Y., will build an equipment storage and service building at Rye, N. Y., to cost $100,000. The Elias Aircraft & Manufacturing Company, Buffalo, N. Y., plans a plant to cost $100,000. The Western New York Electric & Gas Company, Lancaster, N. Y., will build a transmission line from Randolph to Naples, N. Y., and vicinity. The American Can Company, New York, plans a factory at North Chicago, Ill., to cost $1,000,000. The Wright Aeronautical Corporation, Paterson, N. J., plans a plant at St. Louis, Mo., to cost $175,000. The Rundle Manufacturing Company, Milwaukee, Wis., plans a plumbing equipment manufacturing plant at Camden, N. J., including power plant, to cost $1,000,000. The Reyburn Manufacturing Company, Philadelphia, will build an addition to its tag and label plant to cost $350,000. Philadelphia, plans a floodlighting system and lamp beacons at the proposed municipal airport in the Hog Island district, to cost $6,000,000. The Frankford Grocery Company, Philadelphia, will build an addition to its storage and distributing plant to cost $200,000. The William Penn Coal Company, Shenandoah, Pa., plans the electrification of its coal breaker and surface equipment to cost $275,000. The Southern Industries & Utilities, Inc., Francis R. Weller, Mills Building, Washington, engineer, plans a hydroelectric power project near Aurora, Ky., on the Tennessee River, with capacity of 240,000 hp., to cost $30,000,000. The United States Coast Guard Headquarters, Washington, will receive bids until April 15 for spare parts for engines and generators. The General Purchasing Officer, Panama Canal, Washington, will receive bids until April 16 for electrical equipment for four towing locomotives (Panama Circular 1952.)

Motor Sales Are a Factor in St. Louis District

Manufacturers in the St. Louis district report an exceptionally large volume of sales in medium-sized motors for attachment to pumps, ice machines and other apparatus. Utilities have been buying a large amount of copper on account of the advancing market and some of them have anticipated six months' requirements. The contracts that were reported closed during the past week are for a switchboard with control equipment for a large manufacturing company costing $28,000, additional automatic switching devices for another company costing $3,000 and another switchboard for a paint company costing $7,000, a motor-driven fire pump costing $2,000, a miscellaneous lot of equipment consisting of motors, motor-generator set and a motor-driven pump totaling $5,000, several substation equipments costing from $5,000 to $15,000 and a 250-hp. synchronous motor amounting to $5,000. Construction projects are as follows:

The Mobile & Ohio Railroad Company, St. Louis, will begin additions to its railroad shops at East St. Louis. The Dry Ice Corporation of America, New York, plans a plant at St. Louis, to cost $60,000. California, Mo., plans a municipal light and power plant to cost $60,000. The Acme Pipe & Metal Company, Kansas City, Mo., contemplates a steel fabricating plant to cost $100,000. Salem, Mo., plans a light and power system to cost $25,000. The Oklahoma Gas & Electric Company, Oklahoma City, Okla., plans a steam-operated electric power plant on the Arkansas River, near White Eagle, Okla., to cost $250,000. The Finished Steel Products Company, Pine Bluff, Ark., plans a plant to cost $100,000. The Houston Oil Company, Houston, Tex., plans an oil refining plant to cost $600,000. Marfa, Tex., plans an ornamental lighting system.

Railroads Continue Active Buyers in Middle West

The month of March is expected to close a favorable quarter with an anticipated gain of general business of 10 to 15 per cent over 1928 figures in the Middle West. Present indications are entirely favorable for a continuance of good business for the next quarter. The major activities, steel, automotive, agricultural and railroad industries continue prosperous, with a large amount of seasonal industrial activities noticeable. Railroad equipment purchasing is substantially large as compared with last year's figures. The utility companies are busily engaged in spring construction work with a large amount of maintenance work going on, one utility company's purchases averaging $138,000 per day. Interesting orders that have been placed include 50,000 lb. of copper clad guy wire, 250,000 lb. of triple-braid weatherproof wire, 50,000 lb. of magnet wire and construction orders aggregating $100,000. Jobbers' sales are generally satisfactory. Construction projects are as follows:

The Paper Converting Machine Company, Green Bay, Wis., is taking bids until April 10 for an addition to cost $80,000. The Wisconsin Power & Light Company, Madison, Wis., plans rebuilding its power plant at Fulton, Wis., to cost $80,000 and will rebuild the transmission line from Janesville to Avalon, Wis. The Bohn Aluminum & Brass Corporation, Detroit, will build an addition to cost $250,000. The Cadillac Motor Car Company, Detroit, will make expansions to cost $5,000,000. The Muskegon Piston Ring Company, Muskegon, Mich., will build an addition to cost $100,000. Laurium, Mich., plans an ornamental lighting system. Evanston, Ill., plans to ask for bids in April for an ornamental lighting system to cost $1,500,000. Chicago, Ill., plans an ornamental lighting system on Wabash Avenue to cost $250,000. The Rockford Organ Company, Rockford, Ill., plans a factory to cost $200,000. The Indiana Chair Company, Jasper, Ind., plans a factory to cost $80,000. The Republic Iron & Steel Company, Youngstown, Ohio, will make expansions including the electrification at its local mills, to cost $5,000,000. The Hupp Motor Car Corporation, Detroit, plans an addition to its plant at Fostoria, Ohio, to cost $400,000. New Ulm, Minn., plans a floodlighting system and beacon lamps at its proposed municipal airport. Benson, Minn., plans extensions in its power plant, to cost $75,000. Breckenridge and Red Wing, Minn., Ames, Iowa, and Blair, Neb., plan ornamental lighting systems. The Iowa Railway & Light Corporation, Cedar Rapids, Iowa, plans an equipment storage and distributing plant to cost $40,000.

Varied Orders Placed on Pacific Coast

Manufacturers on the Pacific Coast report weather a dominant factor in the past week's business, the delayed rains slowing up sales of distribution transformers, although the demand for 20 and 25-hp. irrigation motors has strained California stocks to the limit. Jobbers report greatly decreased sales for insulated copper wires because many contractors are buying from hand-to-mouth, pending their expectation of a copper drop, which, however, is not justified by market reports. The big copper wire buyers seem to be divided in their policy, a San Francisco power company having bought 200,000 lb. of weatherproof wire during the past month, while a railroad company shows a disposition to await further developments. The outstanding order covers Westinghouse turbo-electric propulsion equipment for three Coast Guard cutters of size 3,000 hp. The proposed major construction includes a $1,000,000 hotel for Pittsburg, Calif., a $1,500,000 Long Beach auditorium, a $650,000 system of warehouses for a Honolulu transportation firm, a distribution system for the Starr Valley irrigation district near Elko, Nev., and a $1,000,000 addition to the old soldiers home at Sawtelle, Calif.

Central-station buying was light, but jobbers reported inquiries from these sources in the Puget Sound district. The large motor orders included about $10,000 worth, from 150 hp. down, for a mill in southwest Washington and ten of from 20 hp. down to a woodworking plant and machine shop in Seattle.

The merger of the San Juan Pulp Manufacturing Company, the Fidalgo Pulp Manufacturing Company and the Cedar Lake Lumber Company of Bellingham, Anacortes and Everett, Wash., respectively, assures the construction of a $3,000,000 pulp and paper plant in Everett. A $750,000 first unit of a steel mill is planned in Westminster, B. C., a $110,000 cold storage plant in Yakima, Wash., and an ice manufacturing plant at Wilkeson, near Tacoma, Wash. An ornamental lighting system in the business district is planned for Auburn, Wash. Construction projects are as follows:

The Southern Sierras Power Company, Riverside, Calif., will build an equipment storage and distributing plant to cost $170,000 and a power substation at Holtville, Calif. The Home Dairy Company, San Rafael, Calif., plans a milk and dairy plant to cost $175,000. The Board of County Supervisors, Los Angeles, has rejected bids recently received for an engine-generator

set, and plans a new call for bids at an early date. Filici & Perrelli, Gilroy, Calif., plans a fruit canning plant at Oakland, Calif., to cost $400,000. Fairfield, Calif., will construct a municipal distributing system for light and power service, to cost $30,000. Salinas, Los Angeles and Porterville, Calif., plan ornamental lighting systems. The Union Battery Company, Chicago, Ill., plans a factory at Seattle, Wash., to cost $90,000. The Warren-Ross Company, Yakima, Wash., will build a cold storage and refrigerating plant to cost $100,000. The Crown Willamette Paper Company, San Francisco, Calif., plans additions to its mill at Camas, Wash., to cost $2,500,000. The Montana Power Company, Butte, Mont., plans transmission line between Chester and Havre, Mont., to cost $125,000. Circle, Mont., plans a municipal electric light and power plant. Boise, Idaho, plans a floodlighting system and beacon lamps for its municipal airport, to cost $90,000. The Midwest Refining Company, Denver, Colo., plans an addition to its oil refinery at Casper, Wyo., which will cost $500,000.

Copper Rests at 24 Cents; Zinc Higher

The activity that was so general in all the non-ferrous metal markets a week ago is evident only in zinc today. Copper reached 24 cents per pound last Friday, since then, however, the demand has lessened. Weakness of spot lead quotations on the London Metal Exchange has served to lessen the demand for that metal.

NEW YORK METAL MARKET PRICES

	Mar. 20, 1929 Cents per Pound	Mar. 27, 1929 Cents per Pound
Copper, electrolytic	23	24
Lead, Am. S. & R. price	7.875	7.75
Antimony	9.75	9.43
Nickel, ingot	35	35
Zinc, spot	6.825	7.10
Tin, Straits	49	48.875
Aluminum, 99 per cent.	24.30	24.30

Base copper wire price March 27, 1929, 25¾ cents

Activities of the Trade

Weston Net Increased 27 per Cent

The annual report of the Weston Electrical Instrument Corporation, Newark, N. J., for the year ended December 31 last shows net profit of $617,923 after depreciation and federal taxes, equivalent to about $3.45 per share earned on the class "A" stock and $2.45 a share on the no-par common stock. Net profit after depreciation in 1927 was $486,402, so that the increase this year was 27 per cent.

The company's balance sheet as of December 31 last shows total assets of $3,839,945, against $3,739,132 at the end of 1927.

Soviet Orders Electrical Equipment

An order for four large hydraulic turbines and generators has just been placed for shipment to the Soviet Union by the Amtorg Trading Corporation. The business was placed with the Newport News Shipbuilding & Dry Dock Company and the International General Electric Company, according to an announcement made by Saul G. Bron, chairman of the Amtorg Trading Corporation. The order, it is stated, involves an outlay of about $2,500,000, and it is understood that credit terms up to five years have been granted.

According to Mr. Bron, offers were received from a number of countries, but American equipment won out in this international competition, being considered the most suitable for the purpose. The equipment, consisting of four hydraulic turbines of 80,000 hp. capacity each, direct connected to four vertical electrical generators of 77,500-kva. capacity each, and all necessary accessories, will be used in the Dnieper hydro-electric plant now being constructed in the Ukrainian Soviet Republic and will be the first of ten similar units to be installed in this plant, which will be the largest electric station in Europe.

Allis-Chalmers Sales Billed Increase 8.8 per Cent

Sales billed by the Allis-Chalmers Manufacturing Company for the calendar year 1928 rose 8.8 per cent to $36,294,561, according to the company's financial statement just issued. Operating costs rose almost 10 per cent to $33,222,615, leaving operating income of $3,071,946. Details of the company's progress during the past five years are shown in the accompanying table.

Year	Bookings	Billings	Net Income	Earned per Share of Common Stock
1924	$25,979,420	$27,855,523	$3,221,100	$8.01
1925	28,944,401	28,921,357	3,417,368	8.78
1926	32,170,181	30,682,542	3,596,891	9.48
1927	30,651,807	33,352,252	3,182,472	10.02
1928	35,957,197	36,294,561	2,933,909	11.28

Canadian Equipment Firms in Merger

The merger of three large firms engaged in the manufacture of electrical appliances is being arranged under the name of the Amalgamated Electric Corporation, Ltd., with a capitalization of $3,000,000. The firms included in the merger are W. H. Banfield & Sons, Toronto; Benjamin Electric Company, Toronto, branch of the Chicago firm, and the Duncan Electrical Company, Ltd., Montreal. W. H. Banfield & Sons, established in Toronto in 1878, have taken a leading position in the manufacturing of switch and outlet boxes, wiring devices and equipment for commercial and domestic lighting. The Benjamin Electric Company is well known for the manufacture of switchboards and panel boxes. The Duncan Electrical Company produces porcelain goods used in electrical equipment. W. H. Banfield will be president of the new corporation, the headquarters of which will be in Montreal.

Baltimore General Electric to Move to Philadelphia

The Baltimore General Electric Company at 1900 Washington Boulevard will be removed to Philadelphia within the next few months, according to an announcement made by J. Allison Muir, supervisor of the plant. Economic considerations resulting from the construction of a new plant in Philadelphia and plans to concentrate plants of similar character in that city were given as reasons for the transfer from Baltimore. A brass foundry operated by the company will remain at the Washington Boulevard site. It is expected that the transfer of manufacturing operations will be completed within a few months.

THE OHIO BRASS COMPANY, Mansfield, Ohio, announces the opening of a new office at 2143 Railway Exchange Building, 611 Olive Street, St. Louis. This office will be the headquarters of H. W. Kilkenny, district sales manager for the company in the St. Louis territory.

FERRANTI ELECTRICAL, LTD., Hillinwood, Lancashire, England, manufacturer of electrical devices, will establish a branch at Mount Denis, a suburb of Toronto. A modern plant, 110 x 400 ft., will be erected and the principal lines of manufacture will be radio equipment, meters and transformers.

THE AMERICAN BRASS COMPANY, 25 Broadway, New York City, a subsidiary of the Anaconda Copper Mining Company, has acquired the French Manufacturing Company of Waterbury, Conn., manufacturer of brass and copper tubing.

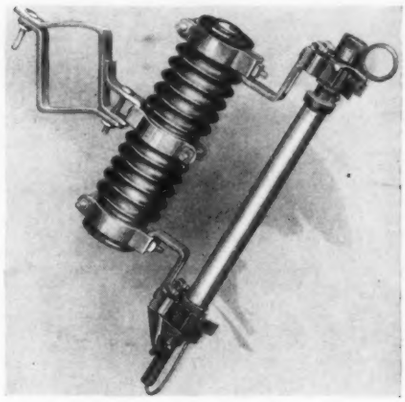
THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY announces that it has received an order covering all the electrical equipment, including the turbo-electric propulsion, for three United States Coast Guard cutters. These new vessels will be built at the yards of the General Engineering & Dry Dock Company at Oakland, Calif. The equipment consists of the main motor, turbo-generator, main condenser and equipment, switchboard and control, together with all auxiliaries above and below deck. When these three new cutters are placed in service the United States Coast Guard Service will have eight new vessels of the cruising type equipped with Westinghouse electrical apparatus.

New Equipment Available

Rural Line Fuse Switches

A complete line of 7,500-, 12,000- and 15,000-volt rural line fuse switches, disconnect switches, fuse switch choke coil combination and disconnect choke coil combination switching equipment is announced by the James R. Kearney Corporation, St. Louis, Mo.

These new one-piece porcelain rural line switches are especially designed to cut installation and maintenance costs. Any switch can be used either as a fuse or disconnect by interchanging the blade or cartridge on the same switch. The one-piece porcelain used is fog type, having exceptionally high wet and dry



flashover. These switches have hot-dipped galvanized iron parts.

Resilient inserts are placed between the porcelain and metal rings to eliminate spot loading on the porcelain. These switches are supplied with standard stamped contacts, having special spring clips to give additional contact pressure, or full floating self-aligning standard Kearney contacts, or ferrule contacts.

The switch is small and compact, so that it takes a minimum amount of space on the crossarm. A universal crossarm hanger is supplied with each switch, this one hanger being for use on any standard crossarm by adjustment. Standard cartridges and blades are supplied on all Kearney rural line systems.

General Utility Outlet

A miniature type utility outlet, No. SP-8000, suitable for rapid installation in floors, baseboards or mantels, has been developed by the merchandise department of the General Electric Company, Bridgeport, Conn. The method of installation and the reduction in the size of the box are made possible by the internal connector, which eliminates long leads and taped joints.

This outlet box consists of a galvanized drawn-steel shell, in which is incorporated a fixture comprising a standard receptacle and a connector for either BX or flexible conduit. Each box is provided with a brass flush plate which is secured by two screws which also hold the entire unit in place.

Electrode Holder for Metallic Arc Welding

An improved type of electrode holder for metallic arc welding designed for greater operator convenience is announced by the Lincoln Electric Company, Cleveland, Ohio. The holder consists essentially of a powerful clamp to hold the welding electrode firmly while welding and with an easy release feature which permits changing electrodes quickly.

In the older types of holder the high amperage welding current was carried through the steel frame of the holder itself and uncomfortable heating frequently resulted under continuous service. In the case of this product the welding current is carried from the point of cable entry to the copper jaws by copper strips of low resistance. The copper tips of the jaws reduce the sticking of the electrode to the jaws, resulting in faster and easier change of electrodes and longer life for the holders, according to the manufacturers. All metallic parts are coated with non-tarnishing cadmium plating. The holder is known as the improved type T.

Rectified-Current Type of Telemetering Equipment

A rectified-current type of telemetering, which is an improved design of remote-metering equipment particularly adapted to transmitting volt and ampere readings of an alternating-current circuit in conjunction with synchronous selector supervisory equipment, is announced by the General Electric Company. The equipment also provides an economical means of telemetering such readings over telephone wires.

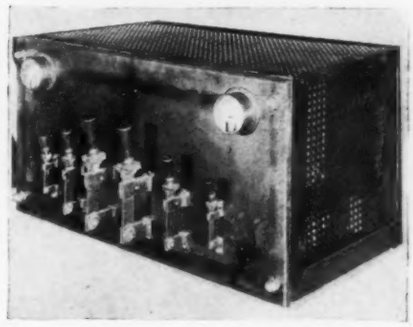
When used with the synchronous selector supervisory system this equipment does not require the installation of extra line wires. One transmitter and one receiver may be connected to any one of the large number of substation circuits.

The synchronous selector system with which this new equipment is designed to operate provides for the centralized control and indication of various types of switching equipment located at outlying substations. With it large or small groups of units can be co-ordinated, and thereby the application is brought to include power systems of all classes. The new equipment consists of a special transformer for each circuit to be indicated, a full-wave rectifier tube, a transformer to supply filament current to the tube, a line wire compensating resistance, and protective equipment to prevent the possibility of high voltage in the event of opening of line wires or damage to equipment. The special transformers are of such design that the rectifier will deliver to the receiver approximately 25 milliamperes at full load current or maximum voltage, as the case may be. The receiving instrument is the standard type direct-current milliammeter adapted to panel mounting. When used in conjunction with a synchronous selector supervisory installation it can be mounted on the dispatcher's control board.

Cast Grid Rheostat

A new cast grid rheostat ruggedly built and designed to withstand plating fumes and acids has been placed on the market by the Fuerst-Friedman Company, Cleveland, Ohio, under the name Columbia unit.

The rheostats afford regulation of both



voltage and current, according to the generator voltage and character of plating. They are of the parallel resistance type. The operating panel is of heavy asbestos board and the knife switches are all of substantial size to withstand much more than the amount of current allotted to them.

Since the generator voltage is fixed usually at 6, 9 or 12, and as the amount of current in any given solution depends upon the amount of anode and cathode surface exposed, it is important to have absolute control of the current and voltage in the solution, which control is effected by means of a tank rheostat. It is claimed that this type of resistor reduces heating to a minimum and eliminates high resistance joints, breakage and loose connections at point of contact.

Weatherproof Socket

Sockets composed of molded "textolite" bodies, to which are assembled a screw shell and center contact with leads attached, and made weatherproof by means of a special bushing, have been developed by the merchandise department of the General Electric Company, Bridgeport, Conn. These sockets are designed particularly for use in outdoor string lighting, signs, damp cellars or any place subjected to dampness, weather, steam vapor or acid fumes.

They are rated 660 watts, 600 volts, and are listed as G.E.-2750 and G.E.-2751.

Electrical Patents

Announced by U. S. Patent Office

(Issued March 12, 1929)

1,704,961. DISCONNECTING BLOCK; T. Birkenmaier, St. Louis, Mo. App. filed Aug. 9 1926.

1,704,978. WELDING STICK; H. W. Knott, Cleveland, Ohio. App. filed Dec. 6, 1920.

1,704,981. METHOD OF PREPARING LUMINESCENT TUBES; P. F. J. Lebrun Paris, France. App. filed Aug. 26, 1927.

1,704,988. STAND FOR SADIRONS; A. Mateen, Cleveland, Ohio. App. filed Jan. 11, 1928.

1,704,990. HANGER BRACKET FOR TROLLEY-WIRE GUARDS; M. Peirce, East Palestine, Ohio. App. filed June 3, 1927.

1,704,996. AUTOMATIC GENERATING PLANT; E. R. Witzel, Kohler, Wis. App. filed May 12, 1928.

1,705,014. MOUNTING FOR SWITCHES AND RECEPTACLES; H. Hubbell, Bridgeport, Conn. App. filed April 5, 1926.

1,705,021. STORAGE BATTERY; J. M. Lea, Detroit, Mich. App. filed Jan. 23, 1922.

1,705,025. ELECTRIC SELF-WINDING MASTER TIME CLOCK; E. A. Meyer, Houston, Tex. App. filed Sept. 17, 1923.

1,705,030. SIGNAL-INDICATING SYSTEM AND APPARATUS; G. M. Sacerdote, New York, N. Y. App. filed March 3, 1926.

1,705,045. TERMINAL CLIP; A. Champion, Flint, Mich. App. filed May 4, 1925.

1,705,075. ELECTRIC-LIGHT SOCKET; D. G. Stoddard, Wayzata, Minn. App. filed June 13, 1925.

1,705,079. RECIPROCATING MOTOR; C. S. Weyandt, Pittsburgh, Pa. App. filed May 5, 1926.

1,705,080. INCLOSED SWITCH; F. T. Wheeler, Plainville, Conn. App. filed Dec. 29, 1925.

1,705,094. REFRACTORY RESISTOR-SUPPORTING PLATE; F. E. Owen, East Palestine, Ohio. App. filed Nov. 4, 1927.

1,705,107. MEANS FOR APPLYING SEALING WAX; F. M. Durkee, Brookline, Mass. App. filed Jan. 10, 1927.

1,705,108. LAMP SOCKET; L. Erikson, Malden, Mass. App. filed May 9, 1925.

1,705,125. ELECTRIC-CURRENT-CONTROL SWITCH; G. E. Kraemer, Cincinnati, Ohio. App. filed Nov. 3, 1925.

1,705,134. RADIANT-HEAT PROJECTOR; A. Papini, Leonia, N. J. App. filed Nov. 21, 1927.

1,705,158. ELECTRICAL INDICATING INSTRUMENT; W. C. McCoy, Cleveland, Ohio. App. filed Jan. 21, 1926.

1,705,159. TERMINAL INSULATION COVER; J. H. Rouse, San Francisco, Calif. App. filed Jan. 28, 1926.

1,705,227. FIRE-ALARM SYSTEM; D. F. Quigley, Bangor, Me. App. filed Feb. 16, 1928.

1,705,231. SHORT-CIRCUITING DEVICE; D. M. Bliss, Chicago, Ill. App. filed July 25, 1927.

1,705,238. COMMUTATOR; J. G. Daloz, Courbevoie, France. App. filed Oct. 12, 1926.

1,705,242. VARIABLE CONDENSER; W. Dubilier, New York, N. Y. App. filed June 10, 1924.

1,705,252. STARTER FOR ENGINES; M. B. Jackson, Toronto, Ont., Can. App. filed Dec. 10, 1926.

1,705,253. INSULATOR FITTING; E. H. Jacobs, Chicago, Ill. App. filed July 11, 1921.

1,705,299. RHEOSTAT; R. H. Maxson, Milton, Wis. App. filed May 5, 1923.

1,705,301. ELECTRICAL MEASURING INSTRUMENT; J. H. Miller Oak Park, Ill. App. filed March 10, 1928.

1,705,323. SIGNAL SYSTEM FOR HIGHWAY INTERSECTIONS; C. Adler, Jr., Baltimore, Md. App. filed March 30, 1928.

1,705,391. THERMOSTATIC SWITCH; P. Bloch and A. Nuñez, Mexico City, Mexico. App. filed Feb. 13, 1926.

1,705,393. CAR HEATING BY CONTROLLER RHEOSTATS; J. M. Bosenbury, Peoria, Ill. App. filed Jan. 27, 1928.

1,705,400. ELECTRIC FUSE; R. W. Gregory, Hexham-on-Tyne, and L. C. Grant, Newcastle-upon-Tyne, England. App. filed May 8, 1925.

1,705,406. DOOR-EDGE CIRCUIT CLOSER; L. P. Hynes and P. M. Griffin, Albany, N. Y. App. filed Jan. 22, 1921.

1,705,417. ELECTRIC WATER HEATER; C. F. Rogers, Jacksonville, Fla. App. filed March 7, 1928.

1,705,446. STROBOSCOPE; A. V. J. Guillet, Paris, France. App. filed March 7, 1925.

1,705,458. ACTUATING TIMER WITH UNIFIED CONTROL; R. D. Smith, Pleasantville, N. Y. App. filed Dec. 15, 1917.

(Issued March 19, 1929)

1,705,518. RELAY; A. J. Gurney, Canton, Ohio. App. filed May 19, 1926.

1,705,524. SAFETY PLUG FOR FLATIRONS; W. T. Hoofnagle, Glen Ridge, N. J. App. filed Sept. 28, 1921.

1,705,534. AIR COOLING AND CLEANING APPARATUS; J. J. Preble, Newton, Mass. App. filed March 27, 1923.

1,705,560. ELECTRICAL INSTRUMENT; P. G. Edwards, Brooklyn, N. Y. App. filed May 5, 1926.

1,705,584. INSULATOR; J. L. Overstall, El Cerrito, and C. H. Sedgwick, Berkeley, Calif. App. filed Feb. 2, 1927.

1,705,646. ARC WELDING GENERATOR; J. Polek, Brooklyn, N. Y. App. filed June 13,1927.

1,705,664. ELECTRIC SYSTEM; J. L. Creveling, Tucson, Ariz. App. filed April 7, 1920.

1,705,671. CONTROL APPARATUS; P. L. Mardis, Edgewood, Pa. App. filed Oct. 24, 1922.

1,705,672. REGULATOR SYSTEM; W. E. Menzies, Irwin, Pa. App. filed June 14, 1923.

1,705,673. BATTERY-CHARGING SYSTEM; W. E. Menzies, Irwin, Pa. App. filed Jan. 22, 1924.

1,705,675. REGULATOR SYSTEM; P. Paech, Berlin-Steglitz, Germany. App. filed Oct. 8, 1927.

1,705,676. ELECTRICAL PROTECTIVE DEVICE; J. S. Parsons, Wilkinsburg, Pa. App. filed Feb. 1, 1924.

1,705,678. THERMAL RELAY; R. T. Pierce, Wilkinsburg, Pa. App. filed Aug. 18, 1921.

1,705,682. ELECTRICAL MEASURING INSTRUMENT; G. Reime, Nuremberg, Germany. App. filed June 4, 1927.

1,705,684. SWITCH; J. Sandin, Penn Township, Pa. App. filed April 12, 1927.

1,705,685. FUSE MECHANISM; M. J. Sandin, Wilkinsburg, Pa. App. filed July 11, 1922.

1,705,687. RELAY SYSTEM; H. P. Sleeper, Newark, N. J. App. filed March 31, 1926.

1,705,688. REGULATOR SYSTEM; S. A. Staege, Pittsburgh, Pa. App. filed July 13, 1925.

1,705,689. SECTION INSULATOR; P. G. Swars, Pittsburgh, Pa. App. filed Jan. 2, 1926.

1,705,690. THERMOSTAT; I. G. Thomas, Mansfield, Ohio. App. filed April 12, 1926.

1,705,692. SWITCH MECHANISM; C. Vogel, Berlin-Schoneberg, Germany. App. filed March 31, 1925.

1,705,694. TEMPERATURE REGULATOR; H. E. White, Wilkinsburg, Pa. App. filed July 1, 1924.

1,705,695. REGULATOR; E. R. Wolfert, Wilkinsburg, Pa. App. filed Oct. 20, 1927.

1,705,696. INCASED HEATER; J. C. Woodson, East Pittsburgh, Pa. App. filed May 15, 1924.

1,705,697. ELECTRIC FURNACE; J. C. Woodson, Mansfield, Ohio. App. filed Oct. 20, 1927.

1,705,698. ELECTRICALLY-HEATED OVEN; J. C. Woodson, Mansfield, Ohio. App. filed Dec. 13, 1927.

1,705,700. CONTROL APPARATUS; B. O. Austin, East Pittsburgh, Pa. App. filed April 15, 1926.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An agency is desired in Alexandria, Egypt (No. 37,149), for storage batteries.

Purchase is desired in Kingston, Canada (No. 37,304), of glass battery jars.

An agency is desired in Berlin, Germany (No. 37,271), for electro-medical appliances.

An agency is desired in Montreal, Canada (No. 37,150), for household electric appliances.

An agency is desired in Vancouver, Canada (No. 37,269), for household electric appliances.

An agency is desired in Mannheim, Germany (No. 37,206), for electric polishing machines.

Purchase is desired in Lyon, France (No. 37,306), of electric or gas household refrigerators.

An agency is desired in Tientsin, China (No. 37,256), for electrically operated baggage trucks.

An agency is desired in Zurich, Switzerland (No. 37,209), for electric vacuum cleaners.

New Trade Literature

PULVERIZED FUEL EQUIPMENT.—The Foster Wheeler Corporation, 165 Broadway, New York City, has issued bulletin No. 37, which covers briefly the development and application of the Aero unit system for firing pulverized fuel. The bulletin contains a large number of illustrations showing plants equipped with Aero unit pulverizers and corresponding line drawings giving sectional elevations through the steam-generating units. The method of operation of the Aero pulverizer is clearly described and the various parts of the machine are shown. The results of tests, are well as a list of prominent users of Aero pulverizers by industries, also are included.

SWITCHES.—Leaflet No. 20,370 issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., describes and illustrates its type H indoor disconnecting switches of the single-pole, single- and double-throw and selector types.

ELECTRIC APPLIANCES.—The Edison Electric Appliance Company, 5600 West Taylor Street, Chicago, is distributing its dealers' catalog No. Y500 for 1929, covering the "Hotpoint" electric servants. In this catalog are included all new items which have been added to its line since the last edition, notably the new percolator and urn sets. The company also has issued price lists for use with the catalog and a pamphlet covering its modernistic "Hotpoint" radiant heater.

LIGHTNING ARRESTERS.—Booklet No. 264 issued by the Electric Supplies Company, Seventeenth and Cambria Streets, Philadelphia, entitled "Super Protection from Lightning," is the second of a series describing the technical features of the crystal valve lightning arresters as they apply to modern lightning protection.

STOKER.—The Combustion Engineering Corporation, 200 Madison Avenue, New York City, is distributing booklet MR-1, which describes the super-station type "C-E" multiple retort underfeed stoker. The booklet contains illustrations of the various parts of the stoker and drawings showing the installation of the stoker.

PIPE DRILLS.—A pamphlet issued by the Stow Manufacturing Company, Inc., Binghamton, N. Y., describes and illustrates the Stow "Sani" line of pipe cleaning tools used for the removing of obstructions from distant points in all types of piping.

BELT DRIVES.—The Allis-Chalmers Manufacturing Company, Milwaukee, has issued bulletin No. 1241, describing its "Texrope" drives used to operate heating, cooling and ventilating fans without the least annoyance of any kind. Illustrated in this bulletin also are "Texrope" drive installation in a number of different fields.

FANS.—The Century Electric Company, 1806 Pine Street, St. Louis, is distributing leaflets which describe and illustrate its 9-in. alternating-current stationary fans, the 9-in., 12-in. and 16-in. alternating and direct-current oscillating fans, the 36-in. alternating-current ceiling fans, the 60-in. alternating and direct-current ceiling fans and its 16-in. alternating and direct-current ventilating fans.

ELECTRIC HEATING APPARATUS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is distributing catalog No. 250, which describes and illustrates the Westinghouse industrial electric heating apparatus. In this catalog are presented the various types and sizes of the industrial electric heating apparatus which have been developed for those applications where the successful use of electricity has been proved by industrial practice. It also includes concise definitions of heat-treating terms and practices, together with methods of determining the size and capacity of equipment, cost of operation and rate and quantity of production.

Founded 1874—Fifty-Five Years of Service

APR 1 1929

Electrical World

McGraw-Hill Publishing Company, Inc. MARCH 30, 1929 Twenty-five Cents Per Copy

OKONITE CONTROL CABLES

Okonite Control Cables are faultlessly made of selected materials—their dependability and durability have been proved by long and diversified use.

Their quality cannot be written into a specification.

THE OKONITE COMPANY

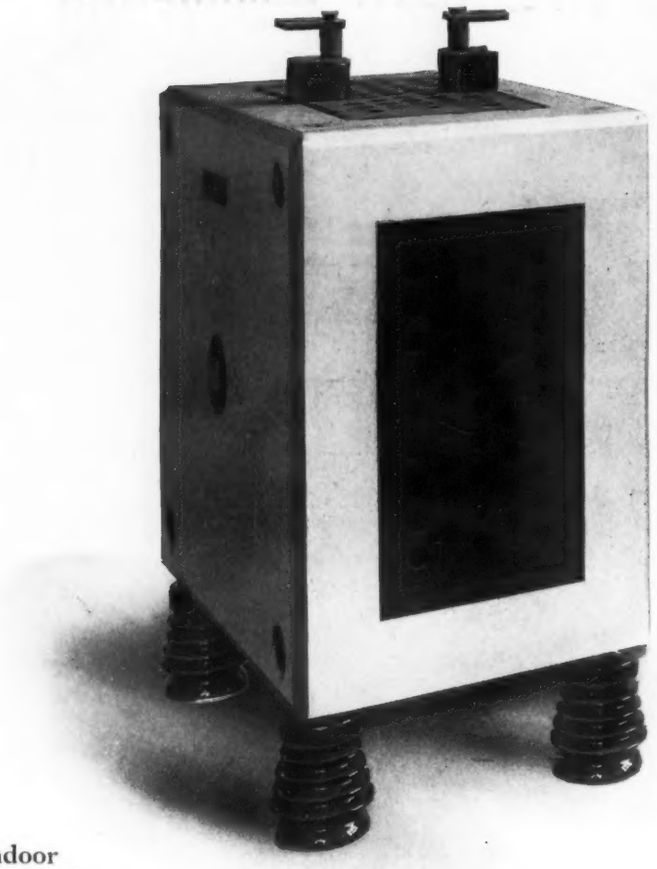
THE OKONITE-CALLENDER CABLE COMPANY, INC.

501 Fifth Avenue, New York

Factories

Passaic, N. J. Paterson, N. J.

The Nerves of the System



Indoor
Feeder Type

MURRAY Low Loss* Reactors

Murray Low Loss Reactors have the shortest conductor lengths and the largest conductor areas. The individual wires of the cable are enamelled to increase still further the reactor efficiencies. This is the reason for the low loss factor of Murray Low Loss Reactors.

All Murray low loss reactor efficiency guarantees are based on measured total losses.

First to use insulated conductors.

First to use enameled conductors.

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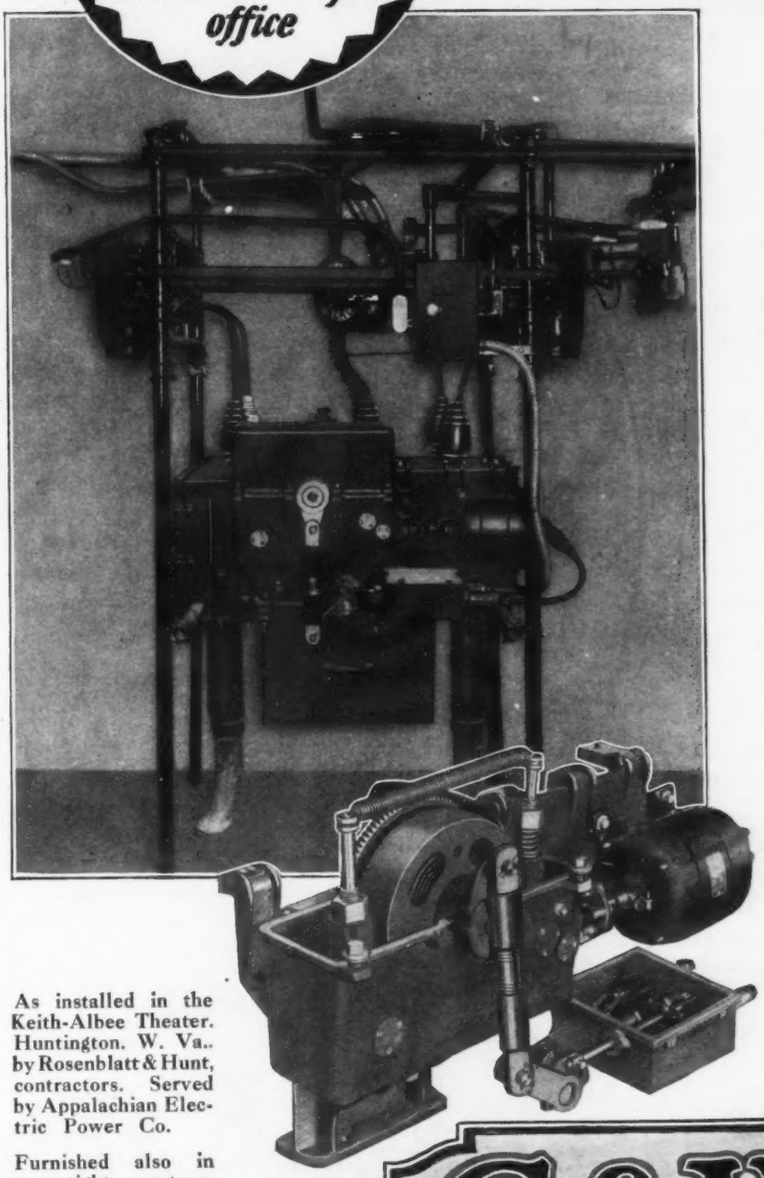
Send for Manual of Reactor Protection

Metropolitan Device Corporation
1250 Atlantic Avenue, Brooklyn, N. Y.

This G&W Transformer Vault Unit

has two remote electrical controls — one in movie operator's booth and other in theater manager's office



As installed in the Keith-Albee Theater. Huntington. W. Va.. by Rosenblatt & Hunt, contractors. Served by Appalachian Electric Power Co.

Furnished also in watertight construction.

prevents service interruptions in large Southern theater

Much importance is now being placed in this vault unit as instanced by its use here in a large modern "movie". On the day preceding the opening of this theater, the vault unit prevented a serious service interruption by automatically throwing over from normal feed to the emergency feed.

This vault unit is a double throw oil switch having on and off position for either feed. It can be furnished for hand operation, for remote manual or electrical control or with full automatic throw-over mechanism.

The vault unit is equipped with by-passes through which load may be carried on either feed with every part of the oil switch dead. These by-pass connections can also serve as a tie between the two feeds, the tie and the load feeding through or by-passing the oil switch as desired.

Its automatic throw-over to emergency with automatic return to normal or preferred circuit, with no possibility of hunting, makes a transformer vault equipped with this unit most desirable for serving important loads.

Simple and safe to operate—submersion proof. All live parts enclosed. Economical of floor space.

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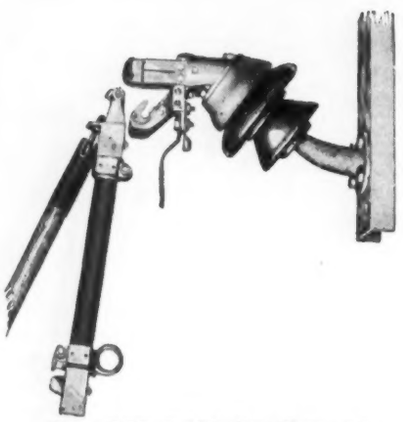
You save on first cost too--

TYPE FV Outdoor Expulsion Fuse Disconnects



Type LVF Combination Fuse and Switch Hook entered into the Key Hole on the Fuse Tube.

Type FV was designed so that only two insulators are necessary. Old style fuse disconnects have three insulators. Even though one insulator was eliminated we made a more compact, substantial and better operating fuse disconnect. Here then is economy in manufacture and materials with a resultant saving to you.

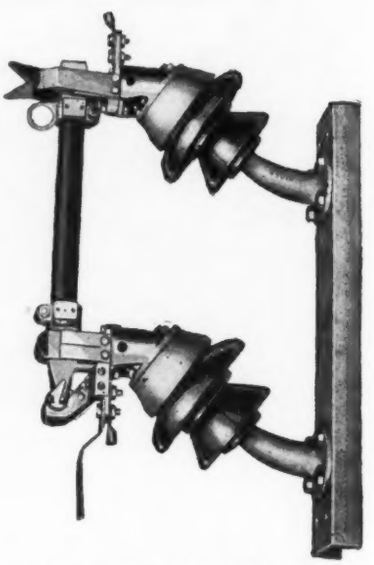
This two-insulator type makes possible smaller mounting structures and takes less time and effort to mount. Better layouts are effected.

This two-insulator type is simple to operate and does not require constant inspection and maintenance.

The operator can make fuse replacements, in much less time using our type LVF Fuse and Switch Hook.

Bulletin No. 118 tells all about Type FV, FVH, and FVF. Ask for a copy.

* SERVICE VALUE



All "Three E" fuse links for all voltages and for all ampe:age capacities from 1 to 75 amps. are made with fuse wire entirely enclosed in a live rubber tube. S & C Fuses may also be used.

*"Service Value" = Low cost per year of service

ELECTRICAL ENGINEERS EQUIPMENT CO.

General Offices and Factory: MELROSE PARK, ILL.

Chicago Office: 205 W. Wacker Drive
Eastern Office: 21 Park Row, New York

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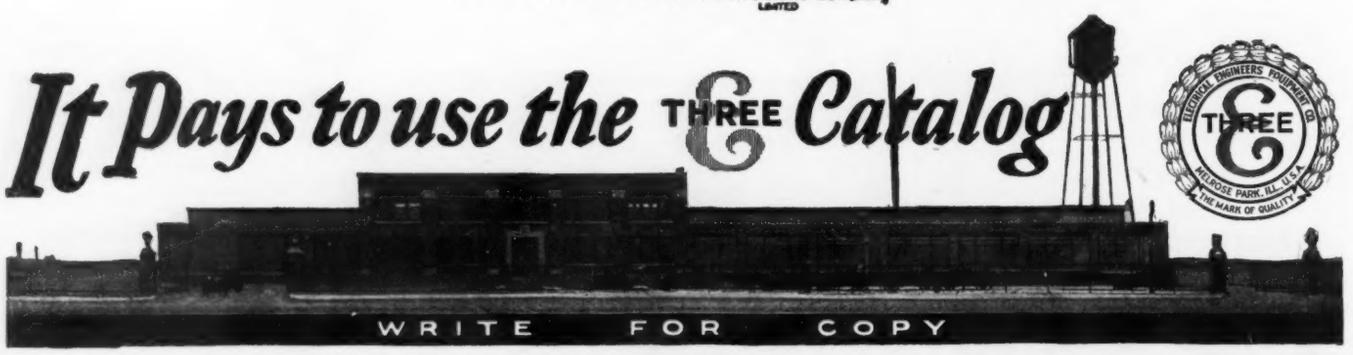
Canadian Representative Northern Electric Company LIMITED

It Pays to use the THREE E *Catalog*



{ONE OF A SERIES SHOWING AMERICAN TRANSFORMERS IN MANY DIVERSIFIED INDUSTRIES}

WELDING SPEEDS PRODUCTION!

WELDING in the automobile field is an acknowledged success. Leading manufacturers attribute at least two major improvements directly to its introduction in their field:

1. Increased production (with increased profits)
2. Stronger, more rigid chassis, frames and bodies.

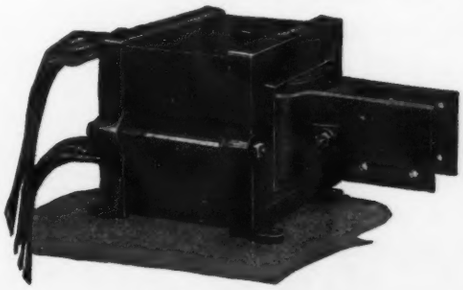
The welding equipment for this purpose must be chosen with care. Of special importance is the transformer used, for upon its efficient performance depends the strength of the weld.

Three factors should be given first consideration when choosing the transformer:

1. Efficiency—(wide range of voltage with a dependable control board)
2. Reliability—(24 hour service, without interruption, if necessary)
3. Economy—(long life with a minimum of repairs)

American Transformers are built to meet the individual requirements of welding machines for spot, seam, arc, flash and other welding methods. Bulletin 1040-B gives complete description of type CF which is used mainly for spot welding.

[There is an American Transformer for every industrial service. Let our engineers advise you on *your* problem—no obligation, of course.]



American Transformer
TYPE CF for welding machines

AMERICAN TRANSFORMER COMPANY

178 EMMET STREET NEWARK, N. J.

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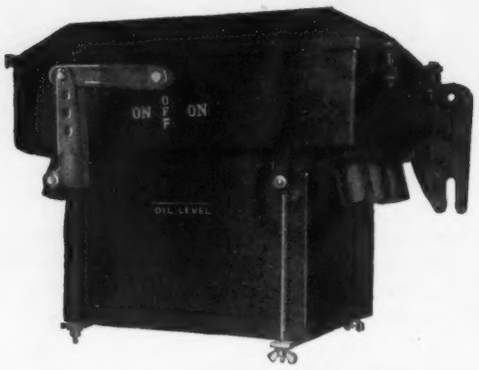
AMERICAN TRANSFORMER

OIL SWITCHES
FOR EVERY SERVICE

Cross Arm Type
4500 volt—200 Amp.
Single Throw
Remote Controlled



Cross Arm or Wall Type
7500 volt—200 Amp.
Double Throw
Remote Controlled

Wall Type
4500 volt—200 Amp.
Single Throw
Hand Operated

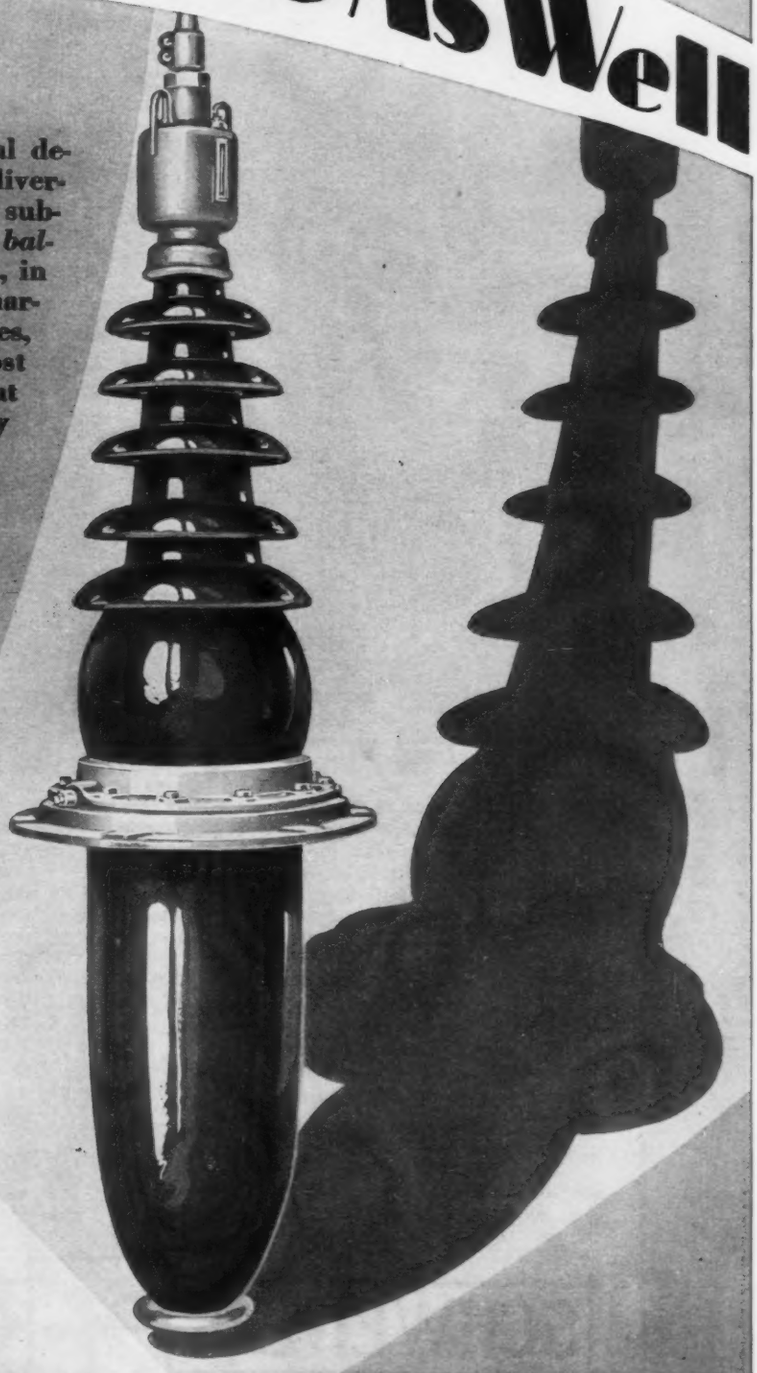
Made in two, three and four pole, single and double throw, remote and manually operated—200 and 400 ampere capacities—4500 and 7500 volt.
Write for Catalog No. 28-A

BLACK & WHITE Ask our Salesman
LINE MATERIAL COMPANY
We make what you want made

LINE MATERIAL CO.
MAIN PLANT SOUTH MILWAUKEE, WIS. " " EASTERN PLANT EAST STROUDSBURG, PA.

In Canada: Canadian Line Materials, Ltd., Toronto, Canada. *Export Department:* So. Milwaukee. *Branches:* Albany, N. Y. Boston, Mass. Chicago, Ill. Cleveland, Ohio Dallas, Texas Denver, Col. Des Moines, Iowa Indianapolis, Ind. Kansas City, Mo. Los Angeles, Cal. New York, N.Y. No. Charlotte, N. C. Oakland, Cal. Portland, Ore.

For Extremes As Well



Oil filled bushings present unusual design requirements, because of the diversity of conditions to which they are subjected. A fine degree of *electrical balance* is essential, for such bushings, in addition to providing an ample margin of safety at normal frequencies, must be able to stand up under most severe electrical disturbances. That O-B Oil-filled Bushings successfully meet these severe requirements daily in all parts of the world, is not only conclusive proof of reliability, but also that the O-B principle of *balanced electrical design* is correctly applied.

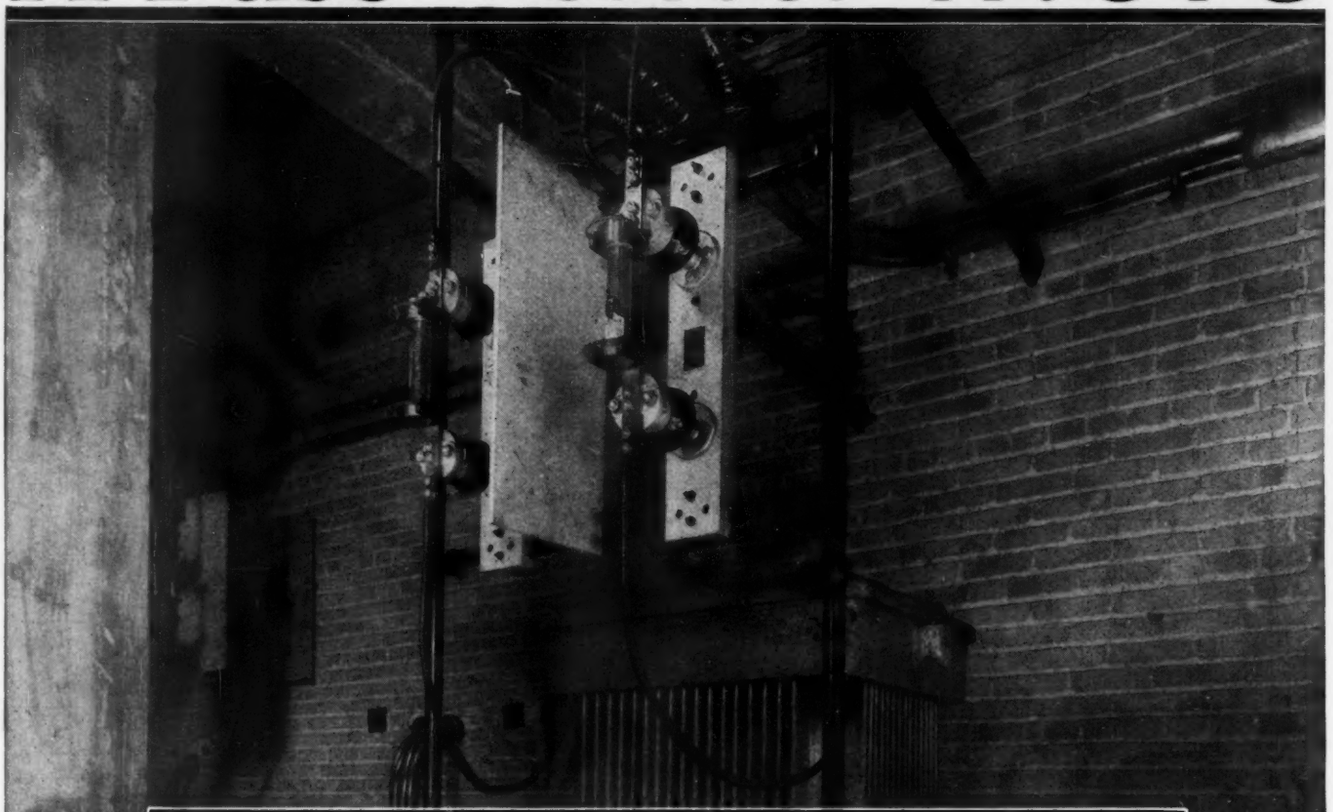
Ohio Brass Company, Mansfield, Ohio
Canadian Ohio Brass Co., Limited
Niagara Falls, Canada
1052H

Ohio Brass Co.

NEW YORK CHICAGO PHILADELPHIA PITTSBURGH BOSTON ATLANTA SAN FRANCISCO CLEVELAND LOS ANGELES

PORCELAIN INSULATORS
LINE MATERIALS
RAIL BONDS
CAR EQUIPMENT
MINING MATERIALS
VALVES

A Fuse—*and more*



THE S&C Fuse is so much more than a fuse that it is more reasonable to compare it with an oil circuit breaker than anything else. In fact, the action of interrupting a circuit by an S&C Fuse, following the melting of the fuse element, is similar to the method employed in oil circuit breakers, yet, with the following additional advantages:

1. The arc is quenched in a liquid which, not only is non-inflammable, but also, is one of the most effective fire extinguishers. The vapors of this liquid will not support combustion nor endanger adjacent equipment.
2. The moving parts of an S&C Fuse possess practically no inertia to interfere with its rapid operation and under short-circuit conditions it clears the circuit in ½ to 1½ cycles, whereas, an oil circuit breaker requires from 10 to 60 cycles to clear the circuit after the trip coil has been energized.
3. When an S&C Fuse is blown under short-circuit, the replacing of the fuse completes the necessary maintenance, whereas, under similar conditions an oil circuit breaker will probably require dismantling, inspection of contacts and replacement of oil, resulting in a maintenance expense many times greater than the refill cost of a set of S&C Fuses.
4. The S&C Fuse has interrupting ability comparable to circuit breakers costing many times as much.
5. An S&C Fuse installation requires comparatively a very small space.

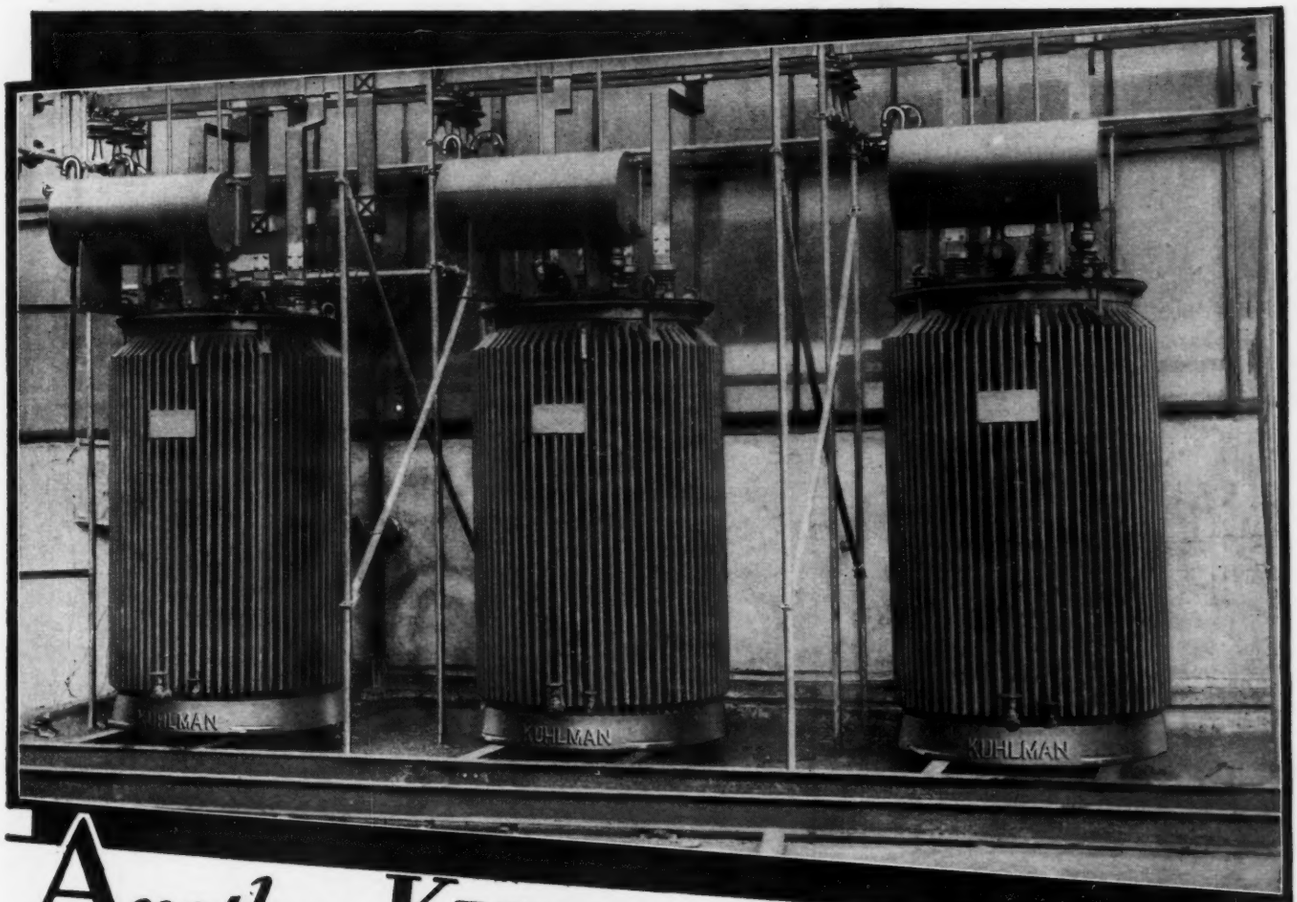
There are places where you can make great savings using S&C Fuses instead of circuit breakers. It is being done. Think it over; then let us tell you more about it.

SCHWEITZER S&C CONRAD, INC.

4435 RAVENSWOOD AVENUE CHICAGO, ILLINOIS U.S.A.

Boston, New York, Philadelphia, Buffalo, Pittsburgh, Charlotte, Detroit, Cleveland, Birmingham, Duluth, St. Louis, Kansas City, New Orleans, Omaha, Denver, Dallas, Seattle, Los Angeles, San Francisco

Japan, T. Hasegawa Co., Osaka



Another KUHLMAN Installation

THIS bank of Kuhlman power transformers is giving a highly satisfactory account of itself in a plant of one of the world's largest automobile manufacturing companies. ¶ Kuhlman distribution and power transformers are day-after-day doing their work well in central stations, industrial plants, theatres, railroads and a host of other special fields. ¶ Each installation is additional testimony to the complete reliability and high operating efficiency of Kuhlman Transformers. ¶ When you are in the market for transformers, get in touch with the Kuhlman office nearest you.

KUHLMAN TRANSFORMERS

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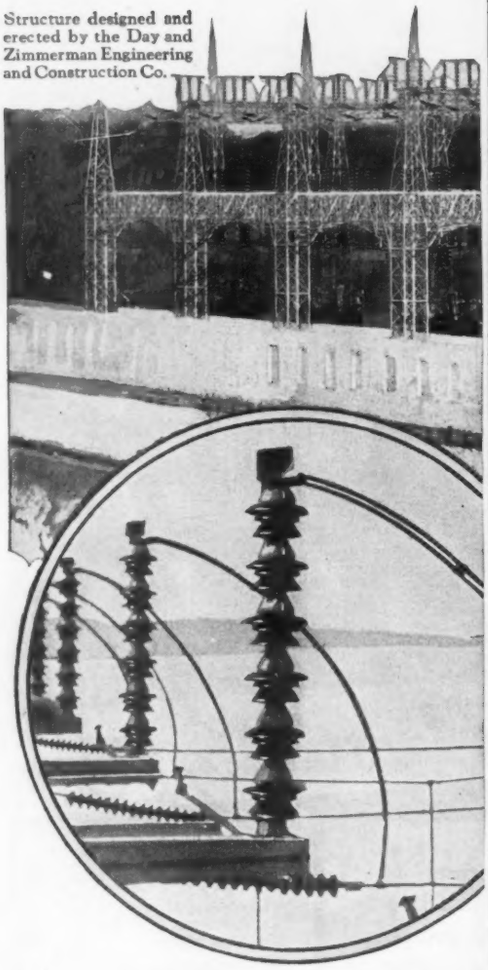
Structure designed and erected by the Day and Zimmerman Engineering and Construction Co.



Open bus tie switch, Conowingo Station. Looking down one of the cross members on top of bus structure showing section of 3-pole-type TTT switches and bus jumpers which are double I. P. S. Anaconda Copper Tubing Connections between switches and 220,000 volt buses.

A typical installation

ANACONDA BUS TUBING

in the Conowingo Power Station

THIS $52,000,000 project, located on the Susquehanna River, is one of the largest hydro-electric developments in the country. Power is transmitted at 220,000 Volts to Philadelphia, sixty miles away, where it is distributed by The Philadelphia Electric Company.

The Conowingo Station is equipped with Anaconda Bus Tubes, supplied by the Railway & Industrial Engineering Company, for bus tie-switches and bus jumpers.

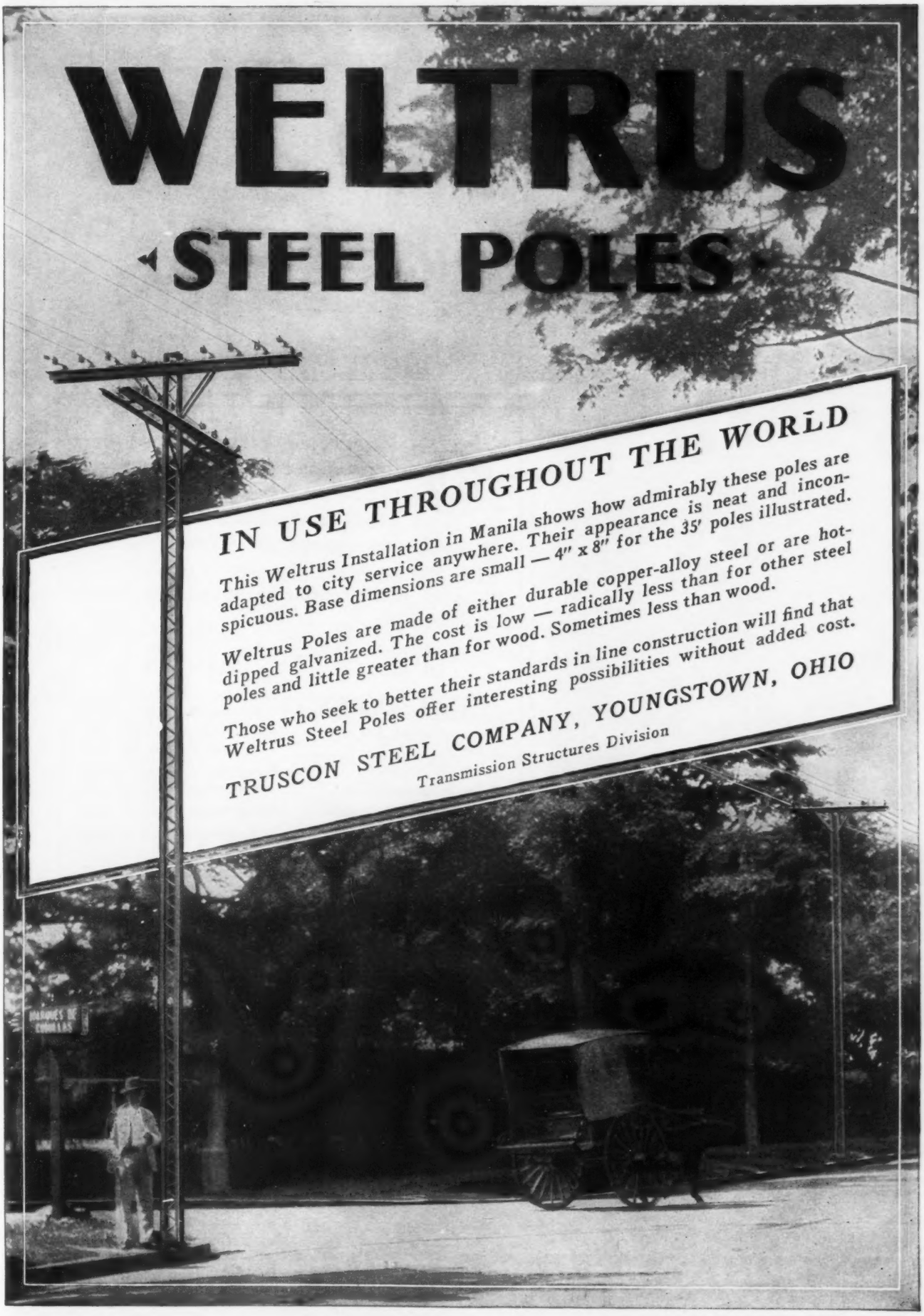
Anaconda high conductivity Bus Tubes are manufactured from copper exceeding 99.9% in purity. They are supplied with a minimum conductivity of 98% when hard drawn and 99% when soft.

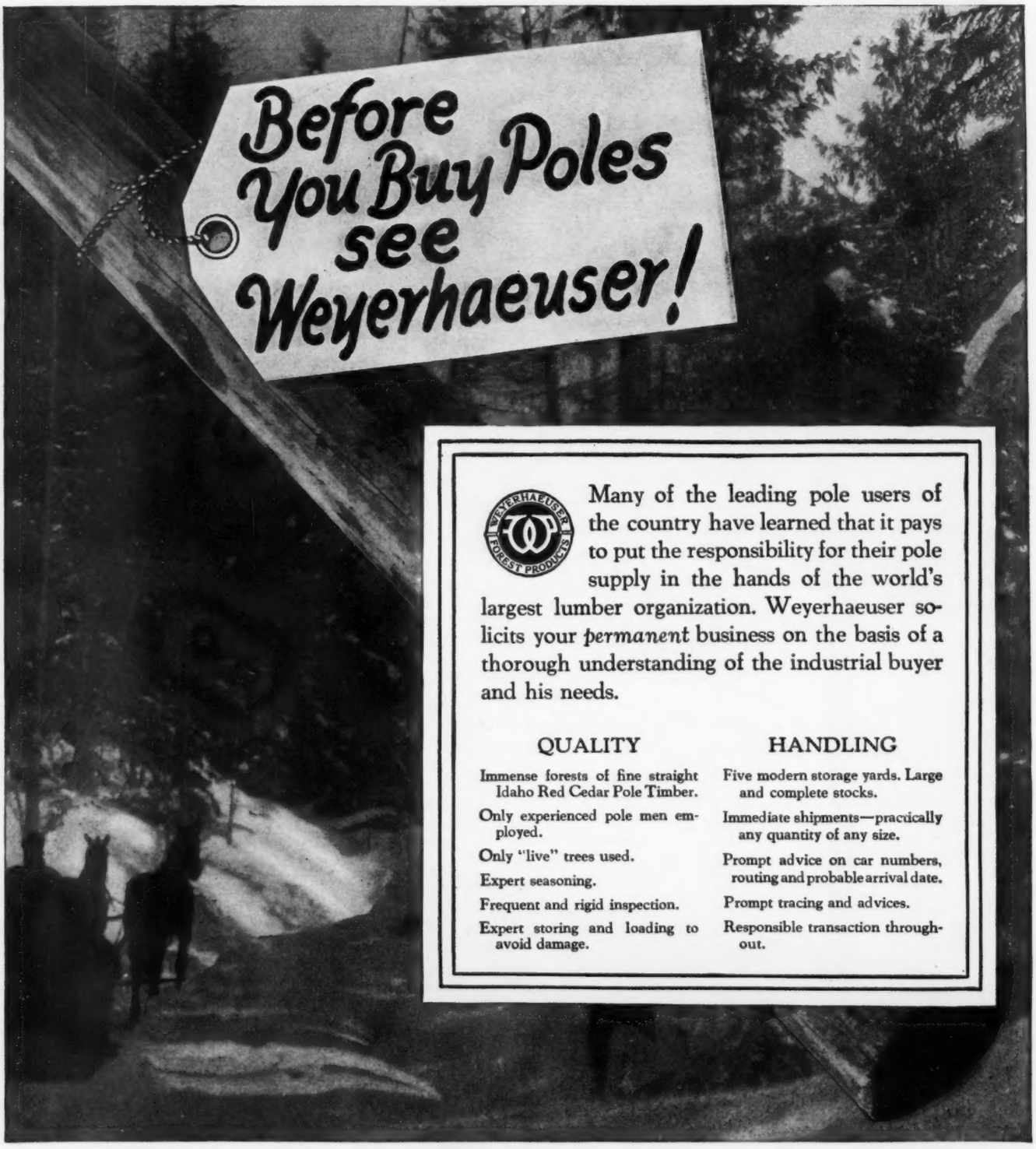
Bus Tube connections are usually made with bolted or soldered fittings, but some engineers prefer to flatten the ends and join with bolts. Anaconda high conductivity Bus Tubes will flatten cold without cracking if finished soft or with a light draft.

Electrical Engineers are invited to investigate the adaptability of Anaconda Bus Tubes to their requirements. Our Electrical Engineering Department is at your service.

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONN.
Offices and Agencies in principal cities.

ANACONDA
COPPER ANACONDA BRASS
from mine to consumer


WELTRUS
STEEL POLES
IN USE THROUGHOUT THE WORLD
This Weltrus Installation in Manila shows how admirably these poles are adapted to city service anywhere. Their appearance is neat and inconspicuous. Base dimensions are small — 4" x 8" for the 35' poles illustrated.
Weltrus Poles are made of either durable copper-alloy steel or are hot-dipped galvanized. The cost is low — radically less than for other steel poles and little greater than for wood. Sometimes less than wood.
Those who seek to better their standards in line construction will find that Weltrus Steel Poles offer interesting possibilities without added cost.
TRUSCON STEEL COMPANY, YOUNGSTOWN, OHIO
Transmission Structures Division



Many of the leading pole users of the country have learned that it pays to put the responsibility for their pole supply in the hands of the world's largest lumber organization. Weyerhaeuser solicits your *permanent* business on the basis of a thorough understanding of the industrial buyer and his needs.

QUALITY	HANDLING
Immense forests of fine straight Idaho Red Cedar Pole Timber.	Five modern storage yards. Large and complete stocks.
Only experienced pole men employed.	Immediate shipments—practically any quantity of any size.
Only "live" trees used.	Prompt advice on car numbers, routing and probable arrival date.
Expert seasoning.	Prompt tracing and advices.
Frequent and rigid inspection.	Responsible transaction throughout.
Expert storing and loading to avoid damage.	

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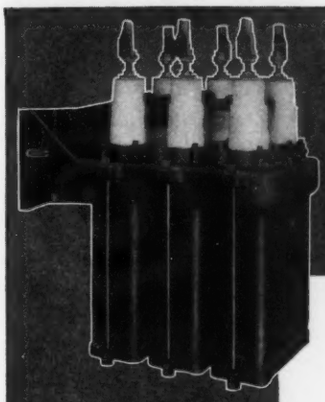
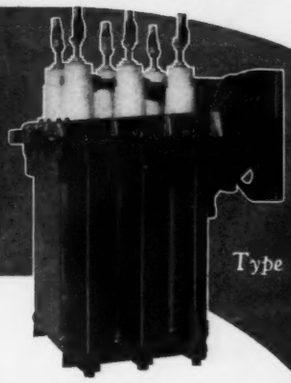
R. L. Bayne, Spokane Office, Manager of Cedar Pole Service

WEYERHAEUSER Idaho Red Cedar Poles

The Condit D-Line



Type D-123



Type D-118

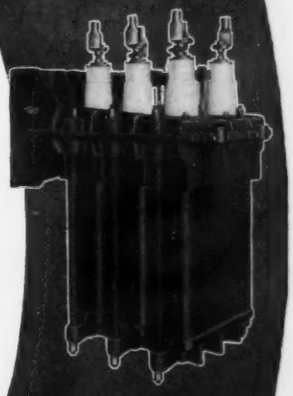
"D" for Dependability

Inverted laminated brushes; exceptionally heavy arcing contacts designed to minimize arcing; massive, rigid frames; deeper tank per pole construction; oversize one-piece wet-process porcelain bushings—the Condit Type D Oil Circuit Breakers have *everything* for safe, dependable, efficient service.

"*Get in touch with Condit*"

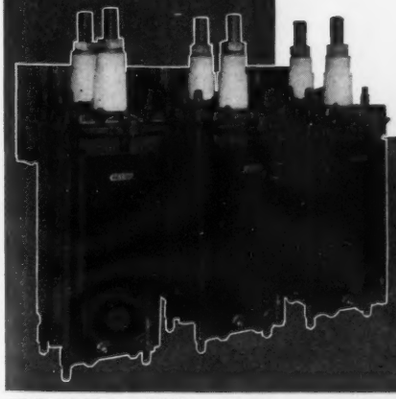
CONDIT ELECTRICAL MFG. CORPORATION
Manufacturers of Electrical Protective Devices
BOSTON, MASS.

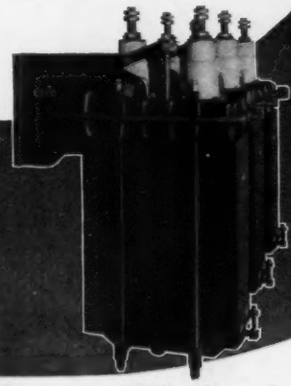
Northern Electric Company
LIMITED
Distributor for the Dominion of Canada



Type D-128

Type D-127





Type D-117

***SPECIFICATIONS:** 1200 amperes or less, 15,000 volts; 1600 amperes, 7500 volts; estimated interrupting capacity at 15,000 volts. Type D-123, 2500 amperes. Type D-118, 3500 amperes. Type D-128, 5000 amperes. Type D-117, 5000 amperes. Type D-127, 7000 amperes.*

CONDIT

2593

ANOTHER
SENSATIONAL / ACHIEVEMENT
by
CYCLONE

H-COLUMN POSTS

STRONGER THAN ANY OTHER TYPE OF FENCE POST OF EQUAL SIZE • •

Six years ago Cyclone announced the now-famous Galv-After process—a revolutionary achievement in fence manufacture. Three years ago Cyclone introduced an improvement equally sensational — Copper-bearing fabric, followed shortly by the first all-copper-bearing steel fence. Now comes the crowning achievement—Cyclone H-Column Posts—making Cyclone a fence of matched strength and endurance in every unit!

Cyclone H-Column Posts are designed especially by Cyclone engineers for Cyclone Fence. Made of special analysis copper-bearing steel. Hot-dipped by the Galv-After process. These stronger posts are now erected with a wonderful new reinforced concrete base which prevents cracking from frost action. Here is the combination for permanence — the post and the base for maximum strength! No increase in price. Write, phone or wire nearest offices.

Cyclone Fence is made in a variety of styles for electrical property, factories, schools, playgrounds, residences, estates, property of all kinds.

Cyclone engineers took their cue from the modern sky-scraper — using H-Column Posts for tremendous strength. Look for the name Cyclone on the web.

© C. F. Co., 1929

Cyclone Fence
REG. U.S. PAT. OFF.

All chain link fence is not Cyclone. This name plate identifies the genuine Cyclone Fence.

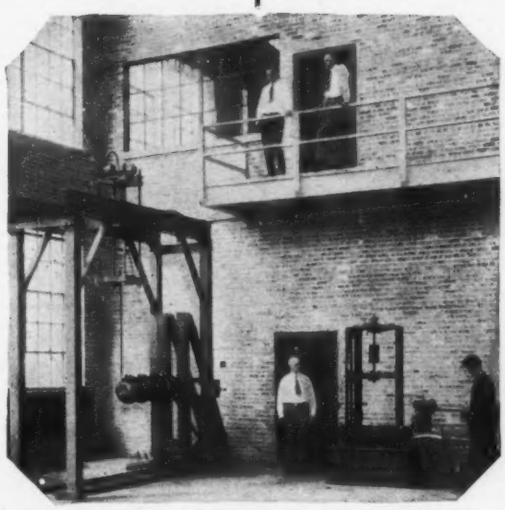
CYCLONE FENCE COMPANY
Subsidiary of United States Steel Corporation
Main Offices: Waukegan, Illinois

Works and Offices: North Chicago, Ill., Greensburg, Ind., Cleveland, Ohio, Newark, N. J., Fort Worth, Texas, Tecumseh, Mich., Oakland, Calif., Portland, Oregon.
Direct Factory Branches in all Principal Cities. Pacific Coast Division: Standard Fence Co., Oakland, Los Angeles and San Francisco, Calif., Portland, Ore., Seattle, Wash.

WE Lost Money—BUT

It is better to be sure than sorry
Buy tested Equipment

It costs less to prevent failure
than to endure it



Two 50,000 pound mechanical testing machines. At the left, a cantilever test. At the right, a tension test on cemented insulator thimbles.

DELTA-STAR
UNIT TYPE PRODUCTS

Air Break Switches
Bus Bar Supports
Disconnect Switches
Gang Switches
Choke Coils—Fuses
Copper Fittings
Solderless Lugs
Pole Top Switches
Outdoor Substations

(Ask for catalog)

¶ Once we delayed a shipment of some new designs of 6000 ampere gang operated switches because upon heat run test the contacts ran a few degrees hotter than they should.

¶ The customer was very much incensed at the delay in shipment but our inspectors could not and would not release the shipment until the guarantees made by our sales department were fully met.

¶ As a result, the switches were rebuilt, we lost money on the order and the customer was riding us hard but when shipped the switches were right and proven so by test.

¶ First designs do not always work out as the designer planned, changes have to be made and shipment may be delayed—but better a late shipment of *proven* and *tested* equipment, than any delivery of unproven or guessed-it-equipment.

¶ Our complete testing laboratory gets at the facts you are entitled to know. If you are buying UNIT TYPE you are getting tested equipment—but are you actually putting "guessed-it" equipment on your lines?

¶ No equipment can do what UNIT-TYPE has done unless it was properly designed, unless its materials were thoroughly tested, unless it was built with precision and tested before it was released from the factory.

A. W. Young
President

MAKERS OF
Delta UNIT TYPE EQUIPMENT Star

DELTA-STAR ELECTRIC COMPANY, 2400 BLOCK, FULTON ST, CHICAGO, ILLINOIS.

Wagner Transformers

Transformers in all commercial frequencies and voltages for industrial plants, sub-stations and distribution systems. The Wagner line is modern in every particular. It completes the Wagner Power Service to Industry.

Write for complete details of Wagner Distribution, Power and Subway Type Transformers.

Literature on Request

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6400 Plymouth Avenue, St. Louis, U. S. A.

Wagner Sales Offices & Service Stations in 25 Principal Cities

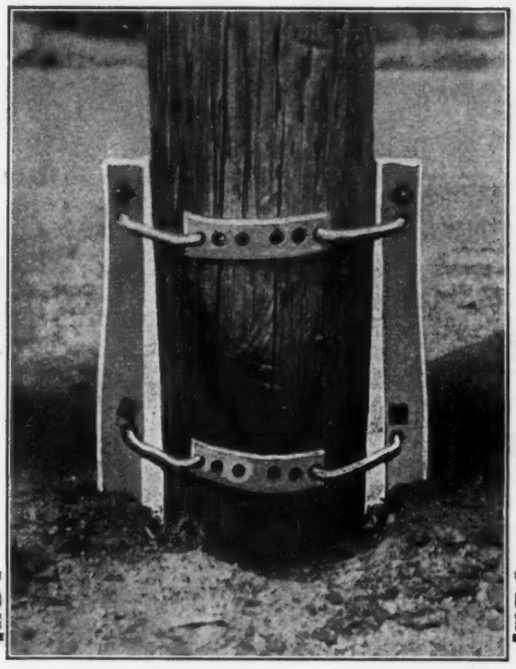
Products: **FANS . . . . . Desk, Wall and Ceiling**
TRANSFORMERS . . . Power, Distribution and Instrument
MOTORS . . . Single-phase, Polyphase and Direct Current

Wagner ... quality

61-6731-8

Announcing

REDUCED *PRICES*



"NEPSCO"

The Pole Reinforcement—
Sturdy and Unswerving!

Nepsco reinforces the pole at the ground line—is quickly installed—easily driven—no digging required.

When the pole has rotted at the base, broken off above the ground or deteriorated generally—Nepsco can be removed and re-used. It is as strong after years of service as the day it was installed.

Increasing popularity and wider distribution have brought considerable reduction (almost 20%) in the cost of this exceptional device.

Realize a substantial saving—effect large economies in pole-line maintenance. Write for Nepsco facts.

Laconia Car Co., Laconia, N. H.

NEPSCO
ECONOMICAL
PERMANENT
SAVE THE POLES
CONVENIENT
OPPORTUNE

MOLONEY TRANSFORMERS

Goodwill

We know that only by giving full value in transformer performance can we hope to keep your good will. That's why every feature contributing to operating economy and long service life have been made a part of Moloney Transformer design.

MOLONEY ELECTRIC COMPANY

Main Office and Factory: ST. LOUIS *Offices in Principal Cities*

The Men Who Know—

Install the FRANKLIN and Forget it

"Lower maintenance costs with FRANKLIN units"—

This is the type of report coming from executives of Mills and Generating Stations using Franklin Equipment.

In this day of exacting requirements and ever increasing demands, Franklin Standard Duty Bus Supports are a dependable means of insulating cables and buses and yet of keeping upkeep down.

Franklin is a sturdy, well made unit for general industrial or mill service, and standard Central Station work.

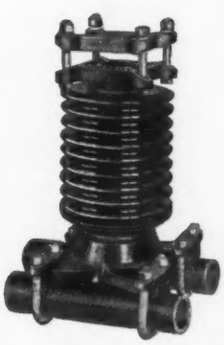
Investigate before investing. Let us show you the margin of quality incorporated in a Franklin investment of both cost and performance.

See section 3200 of the latest R. & I. E. Catalog.

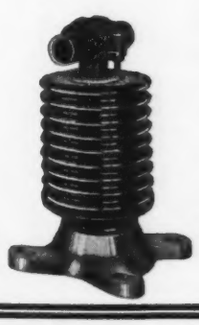
RAILWAY and INDUSTRIAL
ENGINEERING CO. . . . . GREENSBURG, PA.

Representatives in

Boston, New York, Dallas, Indianapolis, Kansas City, Los Angeles, Rochester, Philadelphia, Charlotte, Cleveland, Chicago, Cincinnati, St. Louis, Denver, Albany, Pittsburgh, Birmingham, Buffalo, San Francisco, Toronto, Syracuse, Seattle, Minneapolis



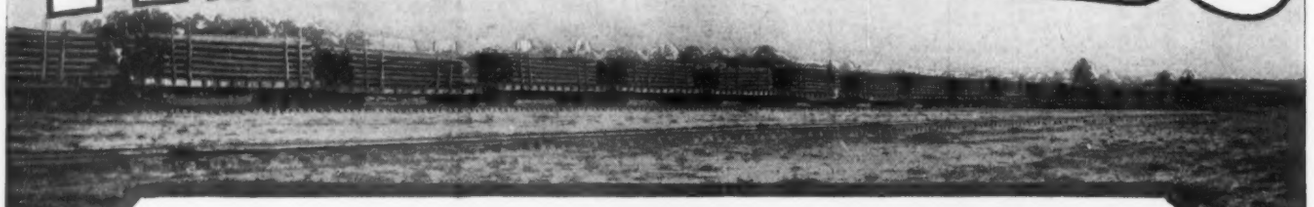
Type "I," Series "A" is a heavy duty unit employing the insert construction.



Type "L" Series "L" Bus Support showing single pipe mounting and round conductor clamp.

— INDOOR BUS SUPPORTS —

TRAIN LOADS



OR CAR LOAD LOTS

But only one high standard of manufacture, including selection of timber, seasoning, framing and a service that has never failed to meet construction requirements.

International Poles last in service. We back up every claim we make—we say they will do only what they have already done. ***International*** has thousands of poles in service 20-25-30 years which are still in an excellent state of preservation. The past experience of hundreds of ***International*** Pole users definitely prove this.

When you purchase ***International*** Poles you are investing in a pole whose durability is not a pathological experiment but a scientific fact. Do not therefore make your power lines an outdoor laboratory for the testing of poles. Continuity of service is paramount and requires a proved strong pole line foundation.

Prompt shipment of highest quality creosoted pine poles can be made from our large supply of poles ready for immediate framing. Specially framed poles in quantity can be furnished on short notice.

Estimates of costs on poles or any pole schedule will be gladly supplied. Carload orders are given the same careful attention as trainload orders.

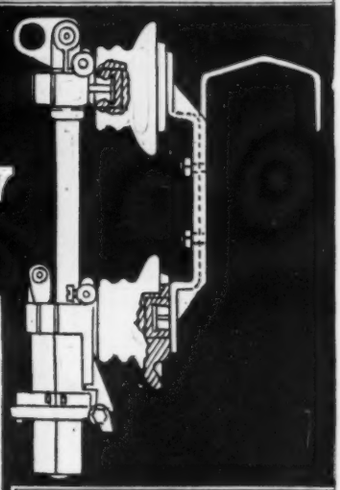
International Creosoting & Construction Co.

General Offices—Galveston, Texas

Plants: Texarkana Beaumont Galveston

International Creosoted Yellow Pine Poles

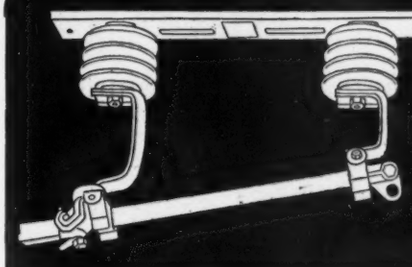
MATTHEWS FUSWITCHES and DISCONNECTING SWITCHES OPEN TYPE



The 1305 Open Type Matthews Fuswitch is popular for transformer and branch line protection on rural or suburban lines where an underslung type of mounting is desired. It has a rating of 100 amperes. By substituting a 5/16 inch bore cartridge a fusible element of 10 amperes is used, and is known as the 1304. These Fuswitches are recommended for operating voltages of 11,000 volts delta or less.

The 1317 Open Type Matthews Fuswitch provides dependable protection at low cost. The fuse cartridge is the patented Matthews Double Tube Vacuum type that assures complete extinguishment of the arc. Rating: 100 amperes . . . 7500 volts with a rupturing capacity of 20 times its rating.

1305



The Matthews Wristogrip makes easy and safe the opening, closing and refusing any make of fuse switches or disconnecting switches mounted vertically, horizontally or at any angle. It is illustrated here with the 1301 Open Type Matthews Fuswitch which is rated at 100 amperes.

Matthews Fuswitches are quickly converted into Disconnecting Switches by substituting a special disconnecting blade for the fuse cartridge. Always use Matthews Fuselinks. They are very closely rated and exhaustive tests prove them to give the best results. W. N. MATTHEWS CORPORATION . . . Engineers and Manufacturers . . . 3702 Forest Park Blvd. . . . St. Louis, Mo. . . . Offices in all principal cities.

W.N. MATTHEWS CORPORATION ST. LOUIS, U.S.A. ESTABLISHED

MATTHEWS ELECTRICAL SPECIALTIES

Power Transformers

Low tension side of a 2500 KVA. single phase, 37,500-12,500 volt Power Transformer built at Pittsburgh Transformer Works.

Pittsburgh power transformers both single and polyphase, have a double magnetic circuit core. The cores are built deep and narrow resulting in low magnetic losses and low exciting current.

The primary and secondary coils are well insulated from each other and from the core, and are wound in the form of an ellipse. The windings form a vertical elliptical sleeve surrounding the inner legs of the core with vertical channels for the circulation of cooling oil.

The copper alloy tanks are from five to eight times more rust resisting than ordinary steel.

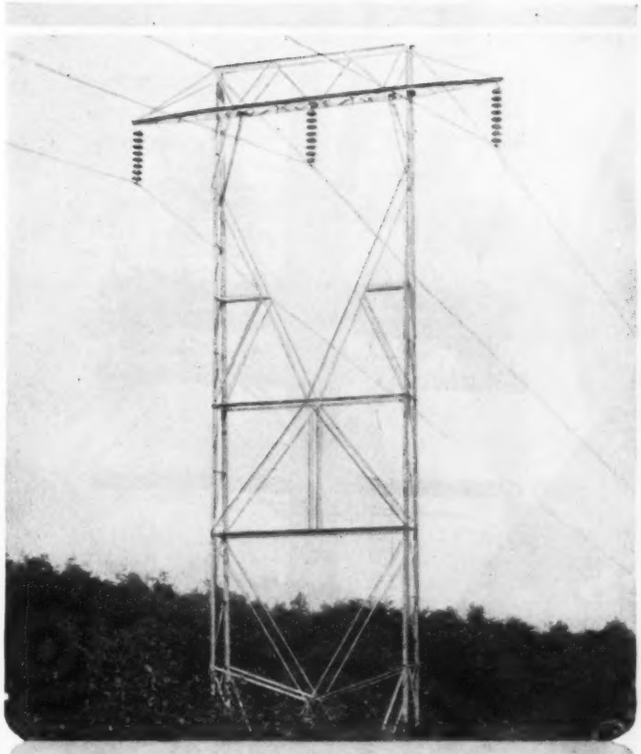
Film type radiators offer extremely efficient cooling surface and are strong enough to permit shipping welded to the tanks and filled with oil.

Rectangular structural steel bases facilitate moving and handling.

ALLIS-CHALMERS MFG. CO.
PITTSBURGH TRANSFORMER WORKS
NORTH SIDE—PITTSBURGH, PA.

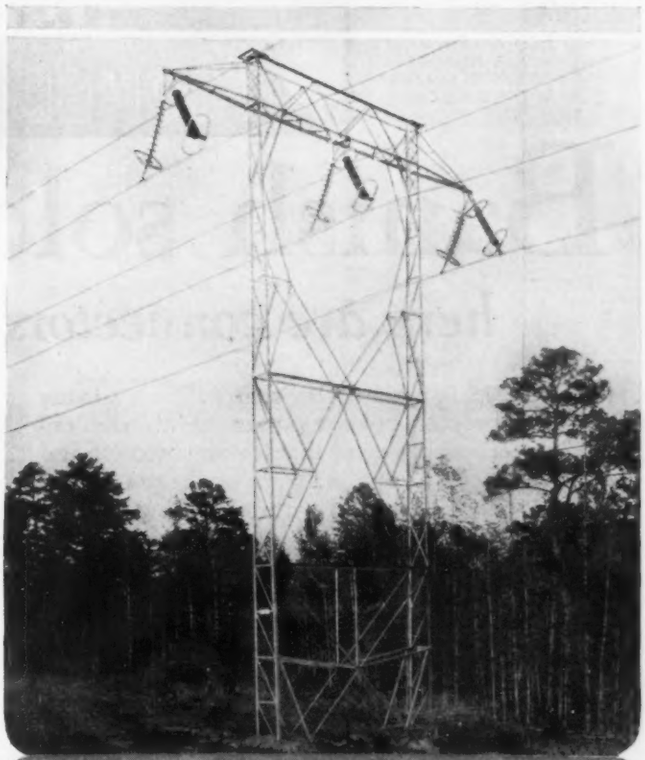
ALLIS-CHALMERS
PITTSBURGH TRANSFORMER WORKS

SEMI-FLEXIBLE TRANSMISSION TOWERS



New England Power Co.
110,000 Volt Line

STEEL TOWERS COMPARABLE IN COST WITH WOOD POLE CONSTRUCTION



Alabama Power Co.
154,000 Volt Line

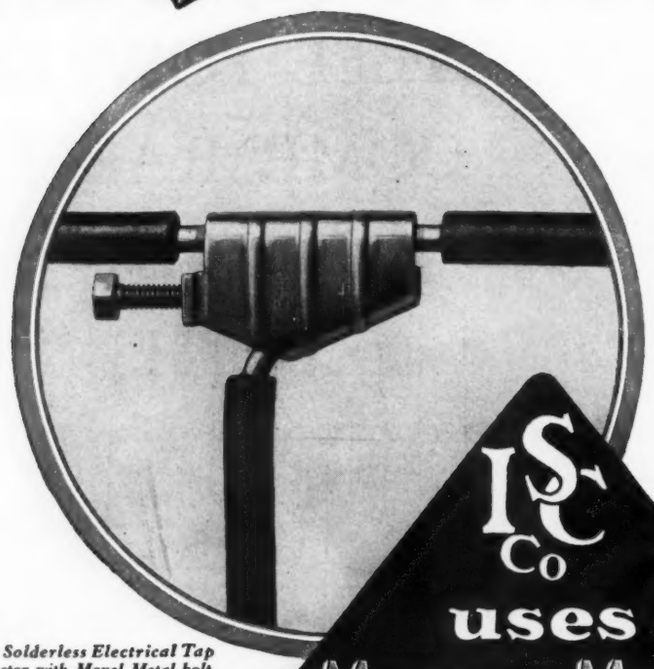
DEPENDABLE lines with low depreciation, elimination of fire hazard, good grounding condition, and small maintenance cost

AMERICAN BRIDGE COMPANY

71 BROADWAY, NEW YORK Subsidiary of United States Steel Corporation

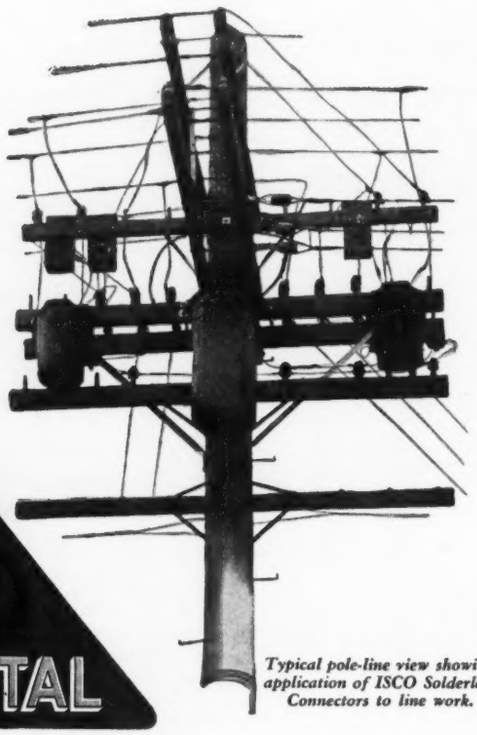
Tower Dept., Frick Bldg., Pittsburgh, Pa.

dependable



ISCO Solderless Electrical Tap Connector with Monel Metal bolt, mfd. by ILLINOIS SOLDERLESS CONNECTOR CO. of Chicago, Ill.

ISCO uses MONEL METAL



Typical pole-line view showing application of ISCO Solderless Connectors to line work.

Banish solder...

here are connectors with Monel Metal bolts

HERE is a connector that will solve many problems of the power transmission engineer—a connector that is non-corrosive and which can be applied without the use of heat or special tools and without cutting the line wire.

Monel Metal bolts form an important part of these ISCO solderless connectors. Monel Metal is used in this equipment for the same reasons it has been adopted for other types of outdoor transmission equipment—because it affords a combination of service properties unavailable in any other material.

1. It has extreme toughness and tensile strength of well over 100,000 p.s.i.
2. It will not rust and it is free from corrosion-cracking.
3. It is not subject to fatigue failures.
4. It has dependable, rolled uniformity.

Foremost engineers and leading manufacturers have learned from experience that the use of Monel Metal bolts and nuts is one of the best ways to insure uninterrupted, dependable service. Monel Metal bolts and nuts should be specified for your equipment to assure economy with safety. Specify Monel Metal for economy's sake!

SEND FOR FOLDER—"FOR SEVERE SERVICE"

Monel Metal is a technically controlled Nickel-Copper alloy of high Nickel content. It is mined, smelted, refined, rolled and marketed solely by The International Nickel Company, Inc. The name "Monel Metal" is a registered trade mark.

MONEL METAL

THE INTERNATIONAL NICKEL COMPANY, INC. — INCO MONEL METAL — 67 WALL STREET, NEW YORK, N. Y.

HOLDING POWER!!

The Essential Factor When Anchors Are Being Specified

DEPENDABLE anchorage year after year is essential. That is why holding power is the factor which brings the ultimate decision for anchor selection. In Kearney Hi-Tension 4-in-1 Expansion Anchors, you will find the answer — they have a greater holding power than any other anchor of equal inches of surface. Tests on any of the five sizes of these anchors will back up this statement —they are all made of certified malleable iron, guaranteed against breakage.

OTHER KEARNEY UTILITY SPECIALTIES

GUY WIRE CLIP

SOLDERLESS SERVICE CONNECTOR

STEEL ROD SCREW ANCHOR

PIPE ROD SCREW ANCHOR

FOR light and power utilities, Kearney Engineers have designed solderless service connectors, guy wire clips, steel rod and pipe rod screw anchors, double duty fuse and disconnect cutouts, fuse, disconnect, and choke-fuse combination switches, handy fuse pullers, bullet type plug cutouts, sleeve twisters with interchangeable dies, hot tap clamps, economy cable clamps, yokes, splice balls, clevises, and underground cable boxes.

Holding Power of Kearney Hi-Tension 4-in-1 Expansion Anchors

Cat. No.	Sand	Clay	Hard Pan
5053	3,000	5,000	7,000
6076	4,000	8,000	12,000
7104	6,000	11,000	16,000
8126	10,000	16,000	22,000
10208	16,000	24,000	32,000

OTHER features of Kearney Hi-Tension 4-in-1 Expansion Anchors include: Ease of installation, capable of being installed in any kind of soil, at any angle, to any depth, and in any location.

Bulletin No. 301 covering Kearney Hi-Tension 4-in-1 Expansion Anchor will be sent on request.

JAMES R. KEARNEY CORPORATION
4224 CLAYTON AVENUE ST. LOUIS, MO.

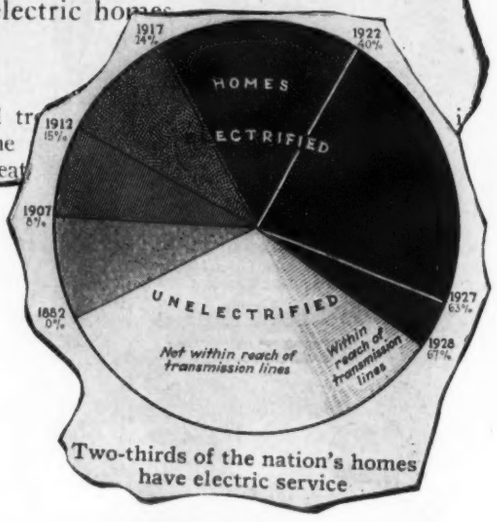
KEARNEY

OVERHEAD AND UNDERGROUND UTILITY EQUIPMENT

Customers Exceed 23,400,000

Number increased by 1,281,220 during year. Over a million new residential users bring total electric homes to 19,012,670

TWENTY years ago there were about 2,000,000 electric light and power customers in the United States. In round numbers the homes electrically its upward tr... From the ... that the great...



Two-thirds of the nation's homes have electric service

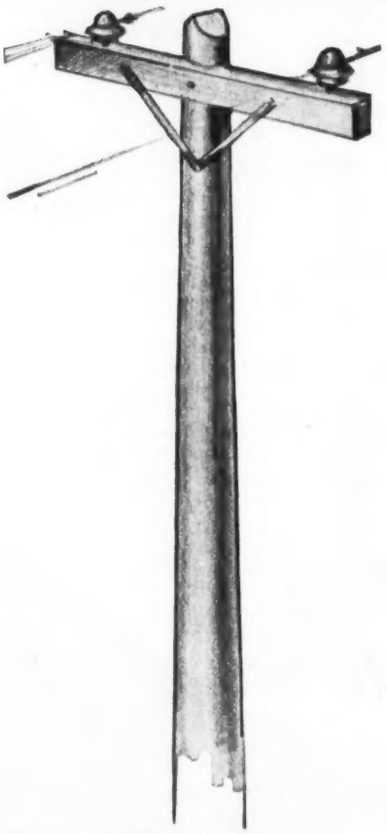
"—and distribution is the thing"

In the rapid expansion of the use of electric light and power, as summarized in the article in Electrical World from which the above heading was clipped, transmission and distribution have undoubtedly been primary factors.

This question of economical distribution will become even more important in the next few years as Central Stations grow and are called upon to meet a constantly increasing and expanding load.

The BROWN organization is equipped to aid the industry in accomplishing this distribution with economy. Pole lines built with BROWN Dense Southern Yellow Pine Creosoted Poles are of long life and the maximum in attractive appearance.

It is because BROWN operates on a one-organization-straight-through method that this company can offer the industry its "new deal in poles"—new in quality, uniformity, and dependability. BROWN raises its poles from the trees, cuts, transports, roofs, frames, and treats the poles entirely with its own men and equipment.



CREOSOTING DEPARTMENT

W. P. BROWN & SONS LUMBER CO., Inc.

Fourth & K Streets, Louisville, Kentucky

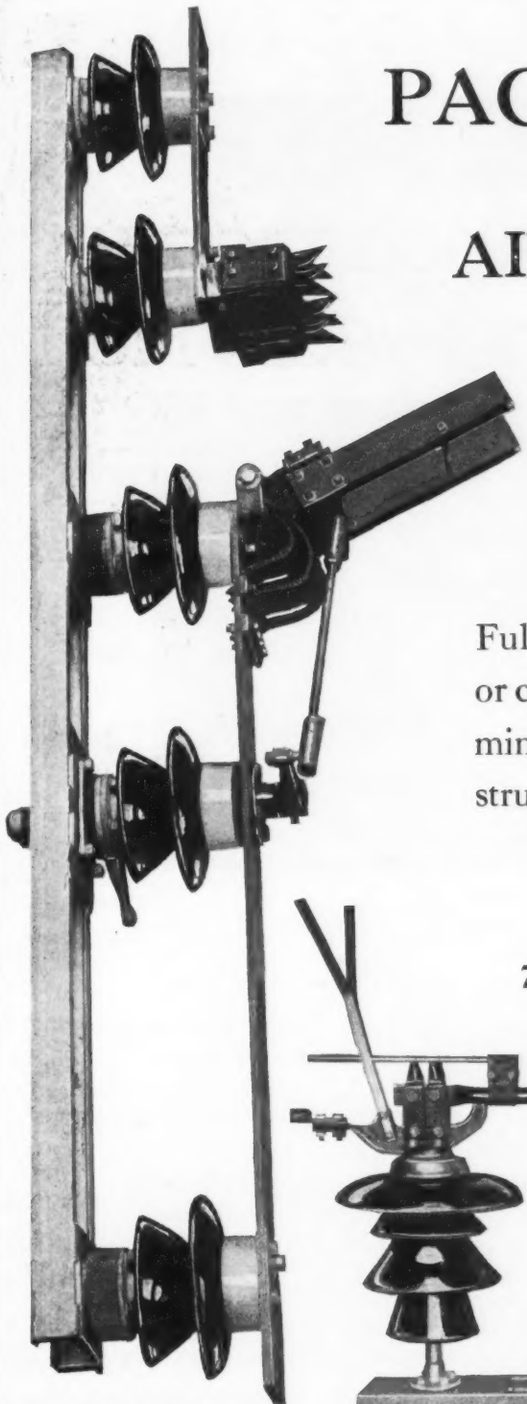
Telephone: MAGNOLIA 2407

BROWN

CREOSOTED YELLOW PINE PRODUCTS

300,000 Acres One of the largest

Individual Holdings in America



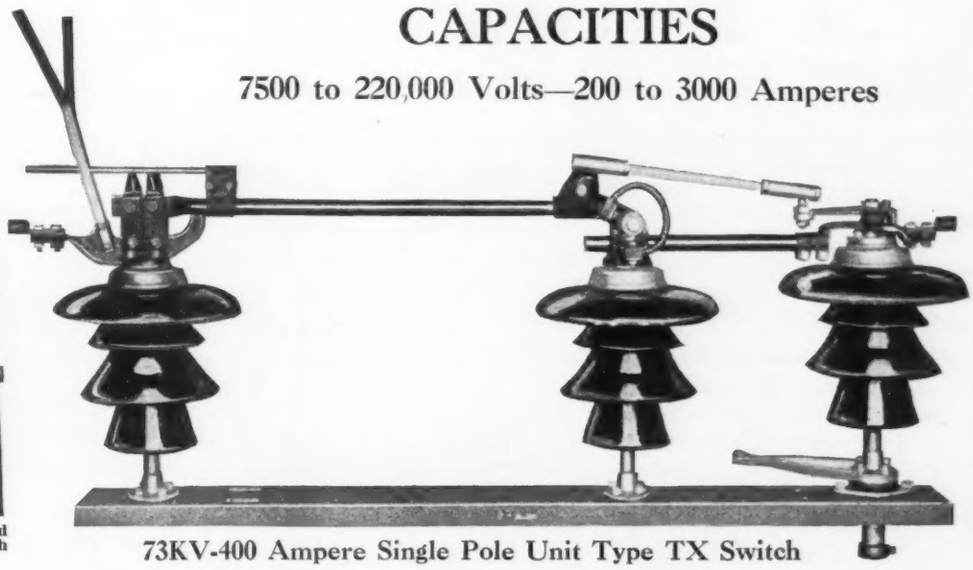
PACIFIC ELECTRIC
TYPE TX
AIR BREAK SWITCH

An Airbreak Switch of the Vertical Break Type that has been adopted by many engineers.

Full-floating, self-aligning contacts. Bus bar or copper tubing blades. Vertical break permits minimum phase spacing, effecting saving in structure costs.

CAPACITIES

7500 to 220,000 Volts—200 to 3000 Amperes



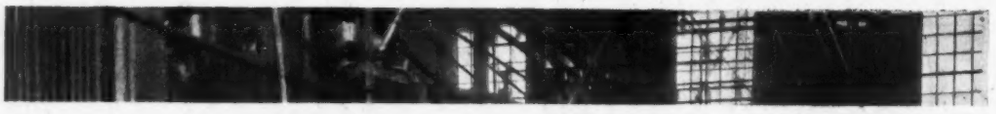
3000 Ampere Vertical Mounted Type TX Switch Equipped with Bus Extension

73KV-400 Ampere Single Pole Unit Type TX Switch

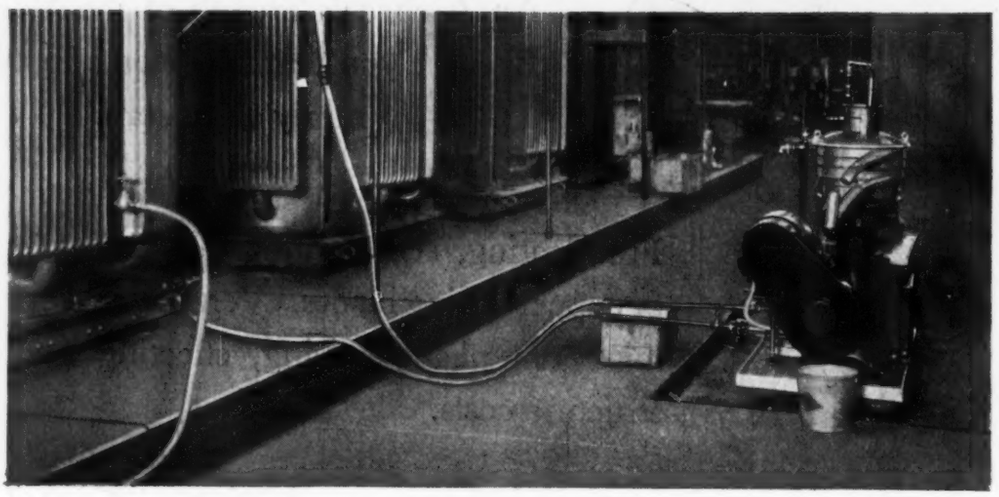
Pacific Electric Manufacturing Corp.

5815 THIRD STREET, SAN FRANCISCO, CALIF.

30 Church St., New York City
310 So. Michigan Blvd., Chicago, Ill.
1111 Healey Bldg., Atlanta, Ga.
635 Allen Bldg., Dallas, Texas
804 Hellman Bldg., Los Angeles, Cal.
American Trust & Savings Bldg., Birmingham, Ala.
516-519 Liggett Bldg., Seattle, Wash.
141 Milk St., Boston, Mass.
1700 Walnut St., Philadelphia, Pa.
918 Dwight Bldg., Kansas City, Mo.
409 Symes Bldg., Denver, Colo.
Pioneer Bldg., St. Paul, Minn.
419 Chemical Bldg., St. Louis, Mo.
1015 Bedell Bldg., Portland, Ore.



Efficient oil dehydration means efficient transformer service



De Laval Transformer Oil Purifier at work in a substation of Chester Valley Electric Company, Coatesville, Pa.

THE first requirement of transformer and circuit breaker oil purifying apparatus is that it effects a thorough removal of impurities. After that *speed* is essential.

De Laval centrifugal purification easily leads in meeting these two conditions—it is the most positive oil conditioning method known, adding to ordinary centrifugal purification the tremendous advantage of the patented De Laval system of strata distribution, which improves the effectiveness of purification and increases the *actual* hourly capacity of the machine.

That is why De Laval Purifiers are used by 88% of the largest electric power systems in America.

The De Laval engineering department will be glad to cooperate with you in order that your transformer oil and switch oil may give the same kind of service that keeps these great systems and hundreds of smaller ones running so smoothly. In writing for further information please ask particularly for Bulletin 107-W.

THE DE LAVAL SEPARATOR COMPANY

165 Broadway, New York 600 Jackson Blvd., Chicago

DE LAVAL PACIFIC COMPANY, 61 Beale St., San Francisco.
THE DE LAVAL CO., Ltd., Peterborough and Winnipeg, Canada.
ALFA-LAVAL CO., Ltd., 34 Grosvenor Road, London, S. W. 1.

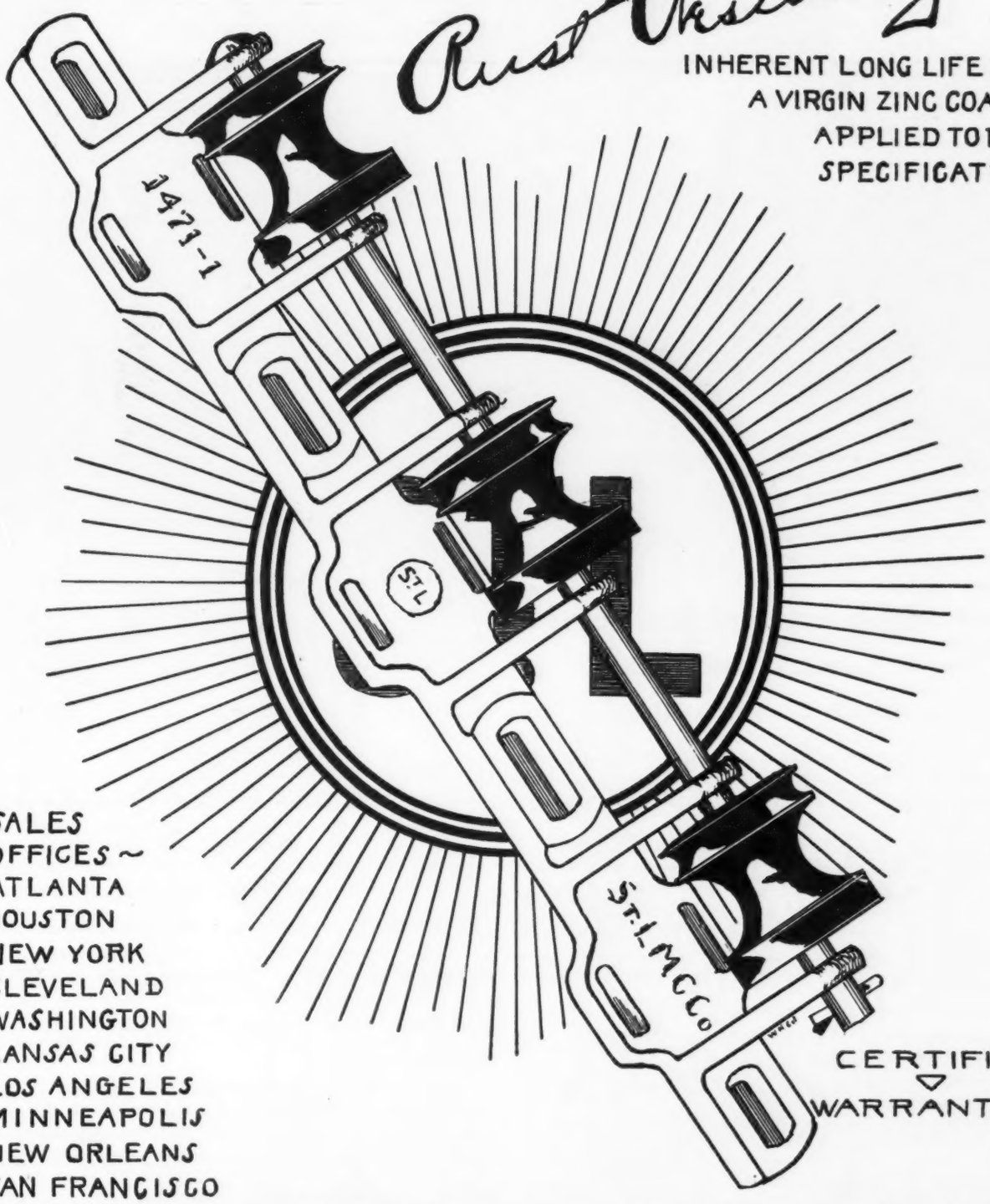
DE LAVAL OIL PURIFIERS

Types for Lubricating Oil and Insulating Oil

POLE LINE SPECIALTIES

Rust-Resisting

INHERENT LONG LIFE PLUS
A VIRGIN ZINC COATING
APPLIED TO RIGID
SPECIFICATIONS



SALES
OFFICES ~
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HOUSTON
NEW YORK
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WASHINGTON
KANSAS CITY
LOS ANGELES
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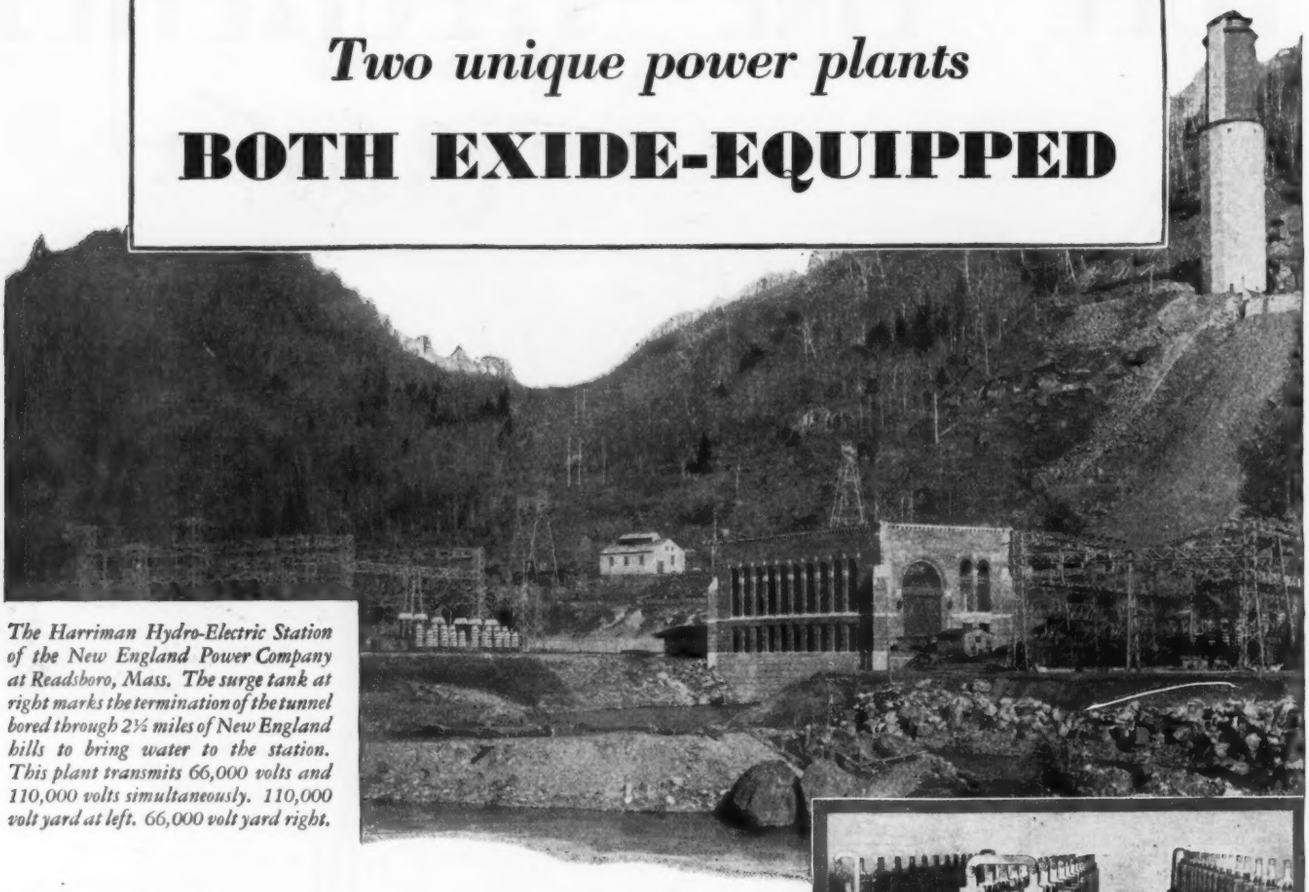
NEW ORLEANS
SAN FRANCISCO

CERTIFIED
▽
WARRANTED

ST. LOUIS MALLEABLE CASTING COMPANY ~ ST. LOUIS, MO.
(ELECTRICAL DIVISION)

ST. LOUIS MALLEABLE

Two unique power plants
BOTH EXIDE-EQUIPPED

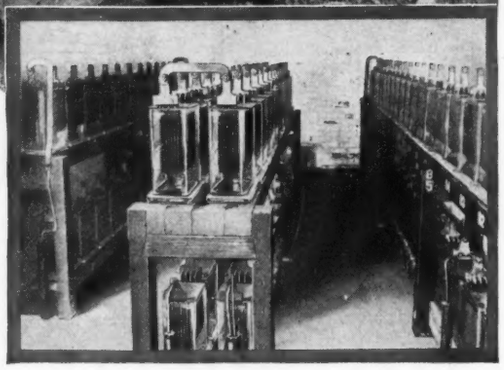


The Harriman Hydro-Electric Station of the New England Power Company at Readsboro, Mass. The surge tank at right marks the termination of the tunnel bored through 2½ miles of New England hills to bring water to the station. This plant transmits 66,000 volts and 110,000 volts simultaneously. 110,000 volt yard at left. 66,000 volt yard right.

Dependable control bus service is assured in these modern stations

OIL circuit breaker operation . . . excitation . . . emergency station lighting . . . here are some of the important jobs that Exide Control Bus Batteries are handling in the central station field.

In both the Harriman and Sherman Plants of the New England Power Company, these batteries insure ample power for oil circuit breaker operation. The Harriman Hydro-Electric Station is equipped with an Exide Battery of 120 cells, 120 A. H. capacity. The Sherman Plant uses an Exide of 60 cells, 320 A. H. capacity. This company uses Exide Control Bus Batteries at four other stations on the Deerfield River; at Shelburne Nos. 2, 3 and 4, and at Station No. 5.



This Exide Control Bus Battery of 120 cells, 120 A. H. capacity insures dependable oil circuit breaker operation for the Harriman Hydro-Electric Station of the New England Power Company.

The Sherman Generating Plant of the New England Power Company, on Deerfield River just below Harriman Station. Automatically controlled. Equipped with 60 cells, 320 A. H. capacity Exide Battery for control bus service.

These up-to-date, carefully planned stations are typical of the hundreds of power plants and sub-stations throughout the country using Exides for control bus service.

Long-lived dependability is the outstanding quality that makes Exide the choice of central station engineers the country over.

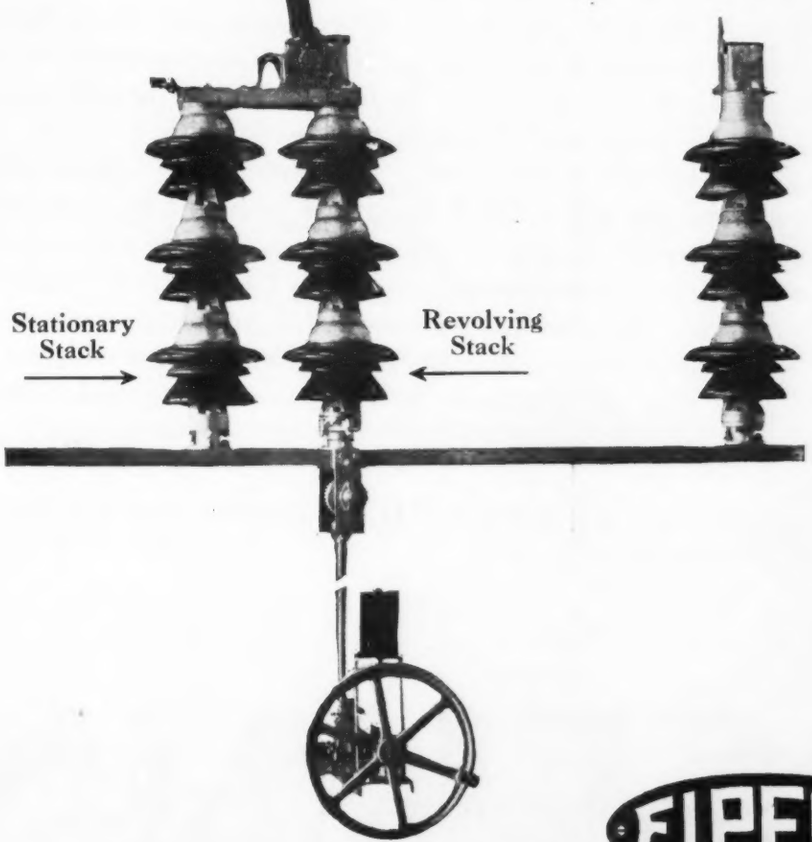
Let us send you our Bulletin 202. It describes the many applications of Exide Control Bus Batteries in the central station field. We'll be glad to send you a copy immediately upon receipt of your request.

Exide
BATTERIES

The Electric Storage Battery Company, Philadelphia

Exide Batteries of Canada, Ltd., Toronto

"Say! . . . *why didn't you think of this before?*"



THIS question was asked an Elpeco representative by a customer in reference to the new TYPE 180 (180° blade travel) switch.

"What impresses me" he continued "is the wide range of application it makes possible."

By that he meant that this switch can be used in the following types:

(a) Single throw.
(b) Single throw with ground connection.
(c) Double throw.
(d) Double throw, selective.

The voltage range is 88, 110, 132 and 154 K.V.—hand or electric motor operation—single or multiple pole for upright or inverted mounting (45° mounting up to 3 insulators per stack).

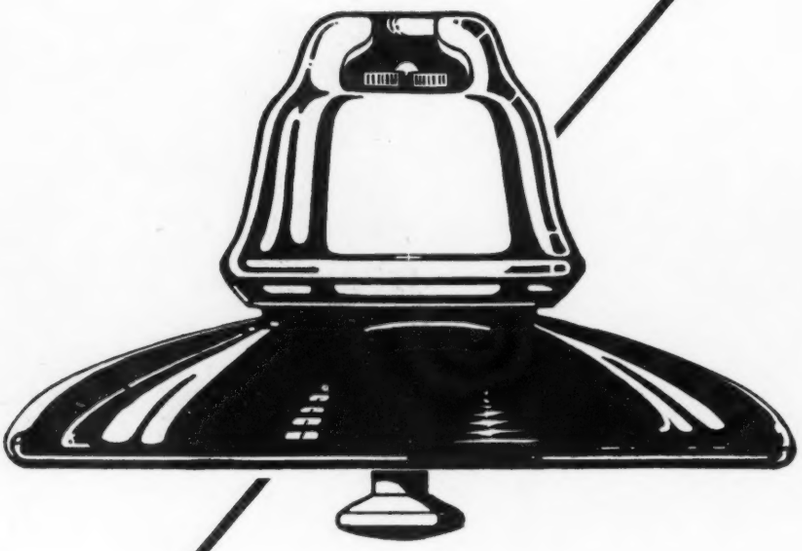
Should you be interested in the details of this type of switch—we will forward to you, on request, ADVANCE PLANOPRINT COPY of bulletin 208, shown on desk above.

for the good of the Service

ELPEC

ELECTRIC POWER EQUIPMENT CORPORATION
412-420 NORTH EIGHTEENTH ST. PHILADELPHIA, PA.

LOCKE



In nineteen hundred and four Locke made and catalogued the first cap and pin type insulator. Since then tremendous strides, both in design and materials, have kept Locke Suspension Type Insulators in the forefront for high quality and utmost reliability.

Locke 18400 Insulator is a combination of ample mechanical strength, high electrical values and extreme ruggedness. Construction engineers readily appreciate the quicker, easier handling which Locke design makes possible. It is nothing unusual for an entire transmission line using Locke insulators to be erected without a single case of insulator breakage. And trouble after installation is unknown.

LOCKE INSULATOR CORPORATION
BALTIMORE MARYLAND

PORCELAIN INSULATORS

If—

YOU ARE A TRANSMISSION ENGINEER—

YOU *want*

LONGER LIFE FOR YOUR LINES
LESS BREAKAGE
FEWER FLASHOVERS
FEWER "KICKOUTS"
INCREASED STORM RESISTANCE
FEWER LIGHTNING SHATTERED POLES

Among the important items contributing to the advantages noted above, are Peirce Pole Top Pins. These Pins are furnished in all sizes and styles including Heavy and Light Channel, Presteel, Pipe, Angle and Solid Steel types.

Insulator fittings are Lead Thread, Spring Thread, Separable Zinc Thimble and Separable Malleable Iron Thimble furnished to fit a one-inch or one and three-eighth inch bore insulator.

The illustration shows a power and signal line in Missouri using Peirce Presteel Pole Top Pins. Peirce Forged Steel Pins are used on the cross arms. Braces and the necessary small hardware complete the 100% Hubbard Construction.

Write to John Lineman at 6301 Butler St., Pittsburgh, Pa., for further details on how Hubbard Equipped lines are "Built to Enjoy Bad Weather."

The answer is

100% HUBBARD EQUIPPED

HUBBARD

Hubbard *and* COMPANY

PITTSBURGH · OAKLAND, CAL. · CHICAGO

ORANGEBURG FIBRE CONDUIT

THOUSANDS of miles of underground electric circuit in all parts of the world have been laid within the safe protection of Orangeburg Fibre Conduit.

This conduit is always uniformly circular and free from dangerous interior irregularities. It is made in uniform five-foot lengths which insure easy handling whether loading, piling or laying in place.

There are many theoretical tests for conduit, but there is only one really conclusive test, and that is its performance in actual use. In this respect, Orangeburg stands alone. For 36 years Orangeburg Conduit has been used with entire satisfaction. This history of successful performance far surpasses that of any other conduit.

For every type of underground electric circuit Orangeburg Fibre Conduit provides cableways easily and rapidly laid, and certain to stand up in use.

We welcome inquiries and are always ready to make suggestions or furnish estimates for the use of Orangeburg Conduit.

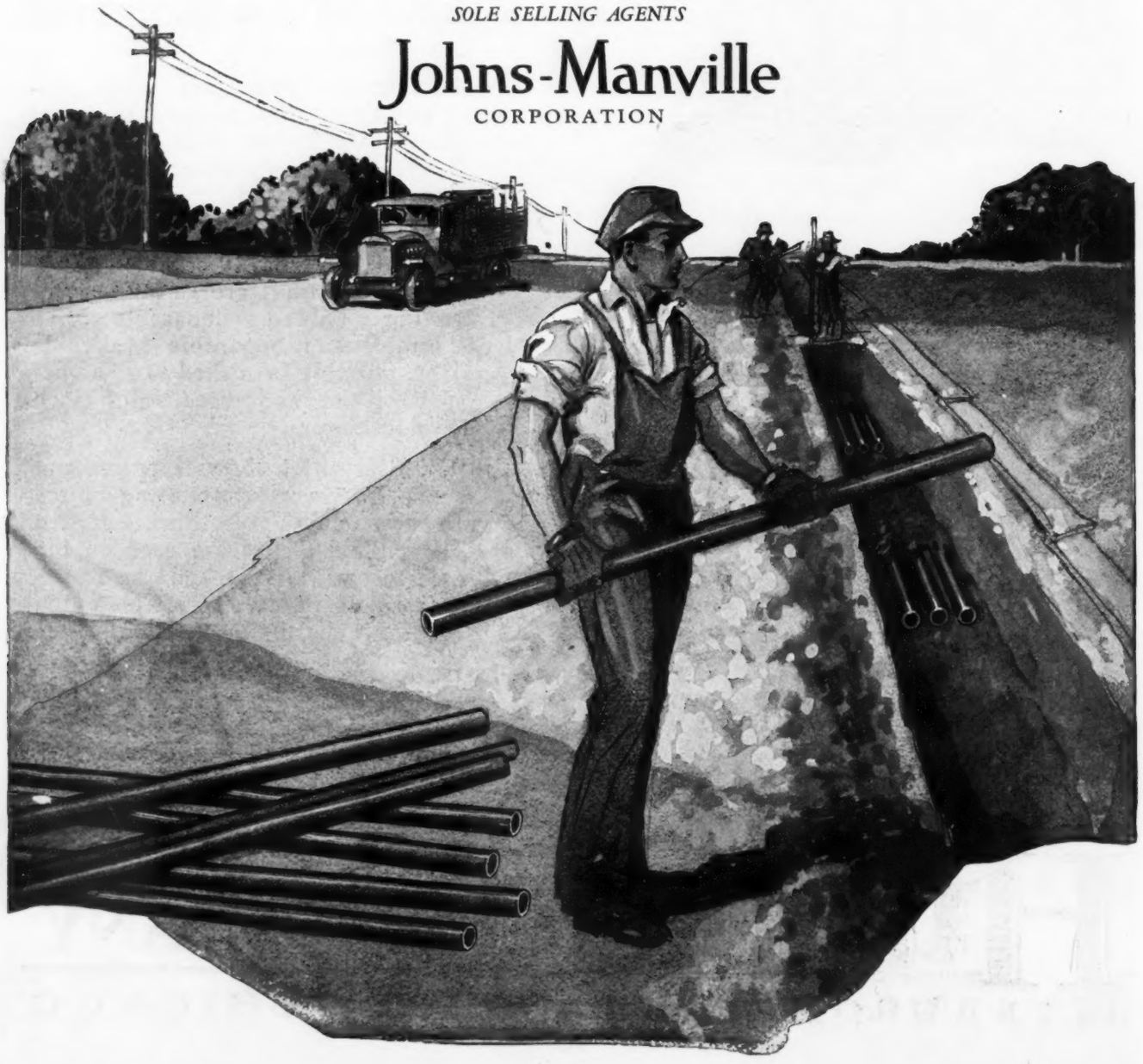
The Fibre Conduit Co.

ORANGEBURG, NEW YORK

SOLE SELLING AGENTS

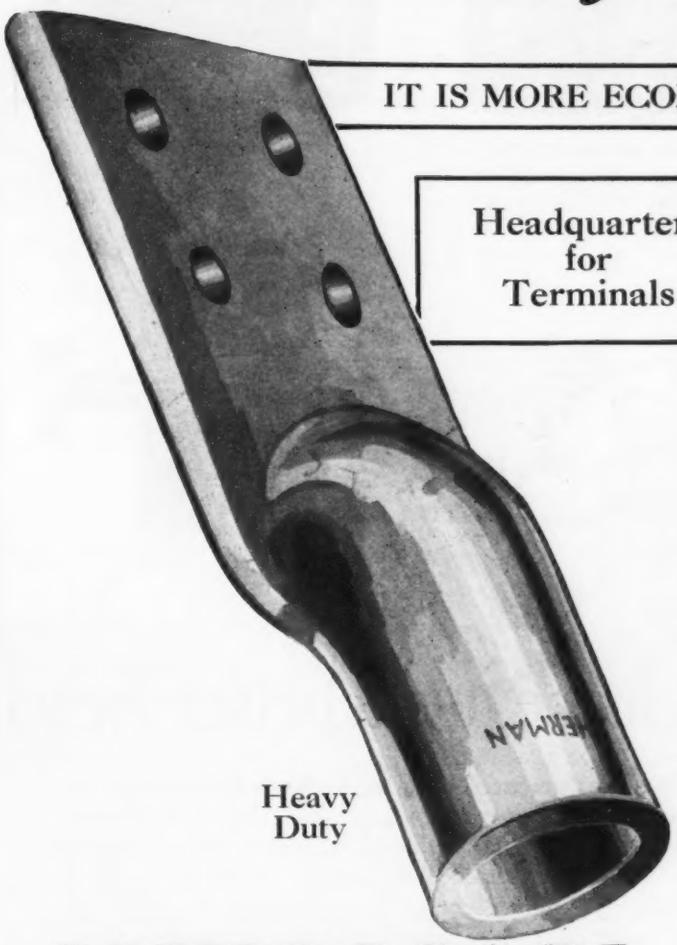
Johns-Manville

CORPORATION



Use Soldering Lugs

made exactly to your needs



Heavy Duty

IT IS MORE ECONOMICAL AND SATISFACTORY

Headquarters for Terminals

The H. B. Sherman Mfg. Co. line of lugs is a practical one and very complete. No matter for what purpose you are now using lugs you will appreciate the advantages of Sherman Soldering Lugs and you will find real economy in standardizing on this line. The H. B. Sherman Mfg. Co. line of lugs was carefully planned and as carefully made. Former lug faults are eliminated—new features are added—these lugs are most desirable and are worth much to you in the better service they render and the better installations they make possible.

The cost of a Sherman Heavy Duty Soldering Lug is negligible in contrast to the cost of the cable it protects. Now you can end the practice of producing your own lugs, a job which at its best is costly and consumes time which could be more profitably applied.

The manufacturer who standardizes on Sherman Soldering Lugs protects his customers.

Central Stations using Sherman Soldering Lugs find them most practical and economical.

Look for Sherman Heavy Duty Soldering Lugs on the equipment you buy.

Headquarters for Terminals

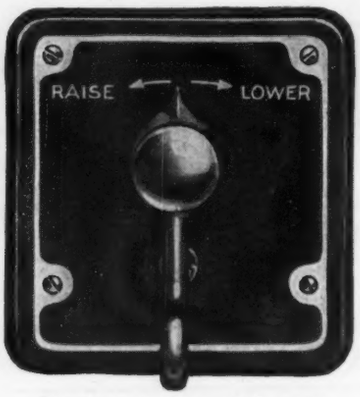
Sherman makes a high quality, complete, and economical line of terminals for the ends of cables and wires. They are now generally accepted as the proper terminals to use because of their exclusive features, advantages, and economy. Ask for descriptive literature.

SHERMAN
HEAVY DUTY
AND
STANDARD SOLDERING LUGS

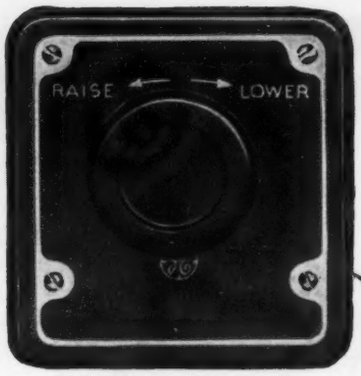
Standard

H. B. SHERMAN MFG. CO., Battle Creek, Mich.

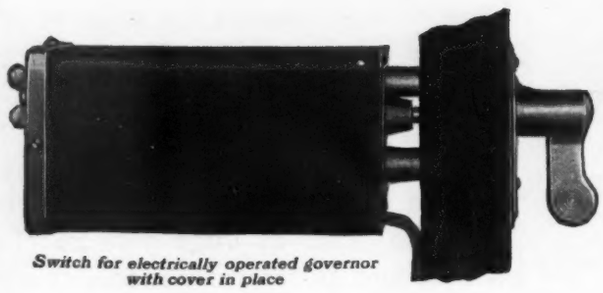
For instrument transfer



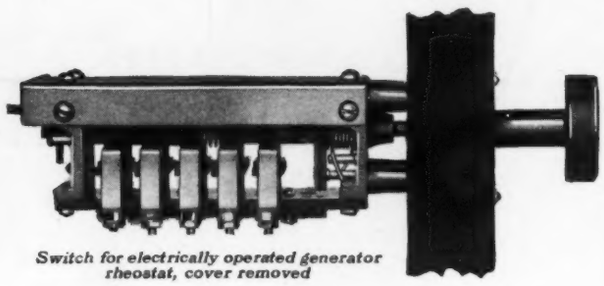
For electrically operated governor



For electrically operated exciter rheostat



Switch for electrically operated governor with cover in place



Switch for electrically operated generator rheostat, cover removed

Cam-operated contacts make this a better switch

Type CL-2 switches are used on switchboards for the control of electrically operated governors and rheostats, instrument transfer, and similar applications. All varieties are of rotary construction. The duty of each, however, is readily recognized by a distinguishing handle. Because cam-operated contacts are employed, instead of the segment and finger construction, greater mechanical and electrical reliability, as well as exceptional ease of operation, is attained.

Type CL-2 switches are furnished in four, nine, and twelve stages as required. For the protection of switch and workmen, a cover of insulating material is provided. The cover is fastened by a single wing-nut, permitting its easy removal for switch inspection.

Type CL-2 instrument switches are available with their cams arranged in different combinations to permit the transfer of the potential or current coils (or both) of various instruments. For this service, switches are equipped with tumbler locks and keys. Standard parts are used throughout; each differs only in the arrangement of the cams relative to the function of the switch.

Every piece of G-E equipment has behind it the services of a nation-wide organization of specialists and a permanent source of renewal parts. For complete information on Type CL-2 control switches, ask the nearest G-E office for a copy of GEA-1045.

500-26

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

Lock it up,

go away,

and forget it.

The American Brown Boveri Mercury Arc Power Rectifier is truly automatic. It takes care of itself by performing the following tasks:

It closes the circuit breaker on the a.c. lines at a predetermined time.

It ignites its own arc.

It connects itself to the direct current bus-bars.

It starts the pump for the cooling water.

It stops the pump if the temperature becomes too cool.

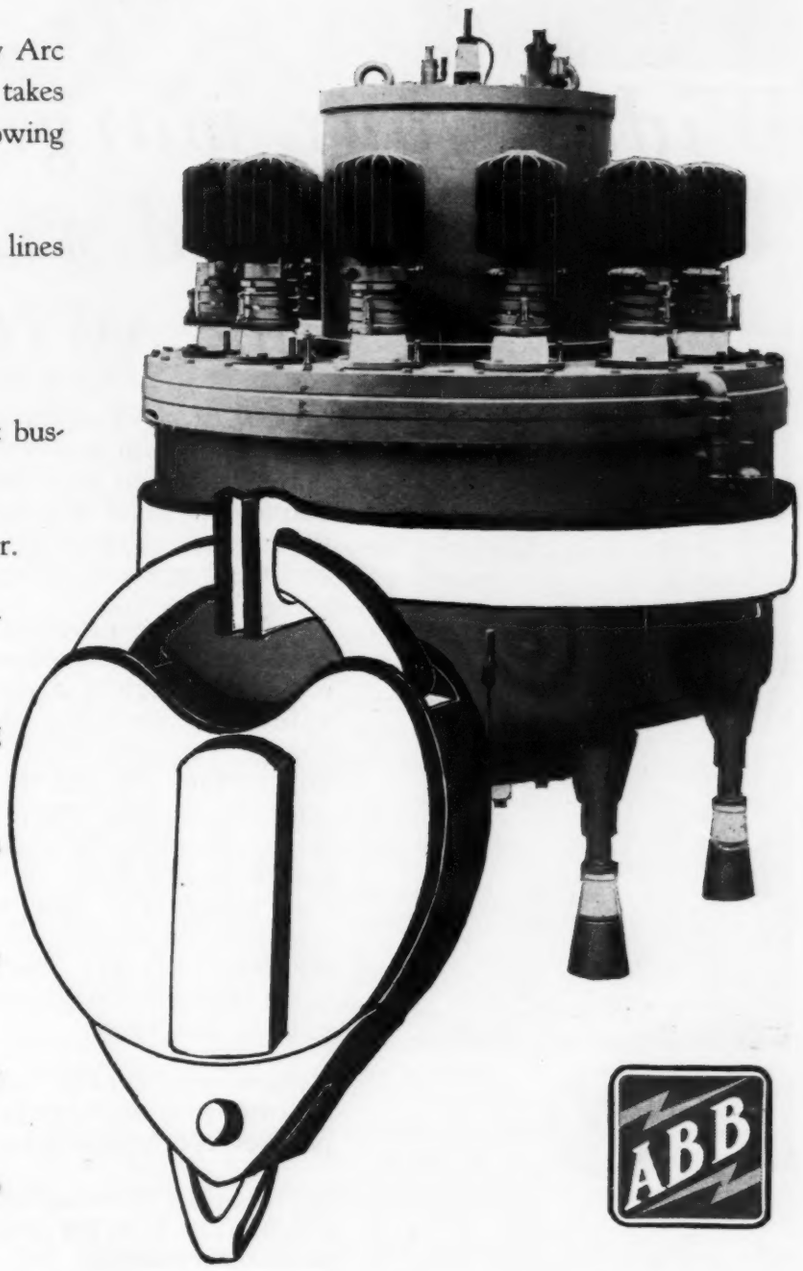
It stops the plant if the cooling water supply fails.

It re-starts it when the water supply is re-established.

If the rectifier gets too hot for any reason, it shuts it down.

It shuts down at stated times as regularly as the whistle blows.

Quite literally, you can lock it up, go away, and forget it.

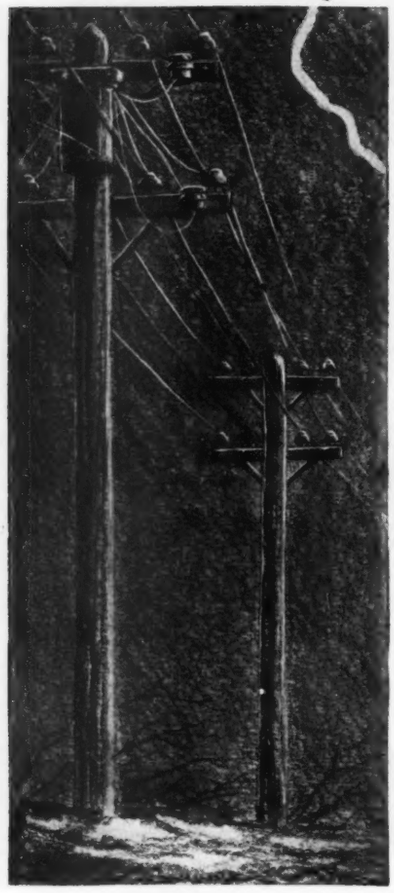


American Brown Boveri Electric Corporation
Camden, N. J.

Representatives in all the principal cities.

AMERICAN BROWN BOVERI

Widen your margin of good will with AUTOVALVES

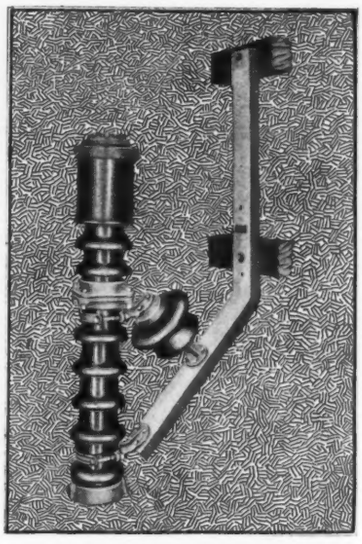


AUTOVALVE arresters are an important protective factor that will widen your margin of consumer good will because of their positive and dependable ability to prevent outages.

An Autovalve prevents outages by starting to discharge before a surge reaches a dangerous value, and they have a large discharge capacity that prevents any serious rise in the voltage after the arrester starts to function. Besides, the discharge is accomplished by a valve action that prevents a flow of power current after the discharge. The operation is very fast because there is no solid dielectric in the path of discharge.

By rendering continuous service, Autovalves are never-failing promoters of consumer good will.

Write to the Westinghouse sales office near you for more complete information.

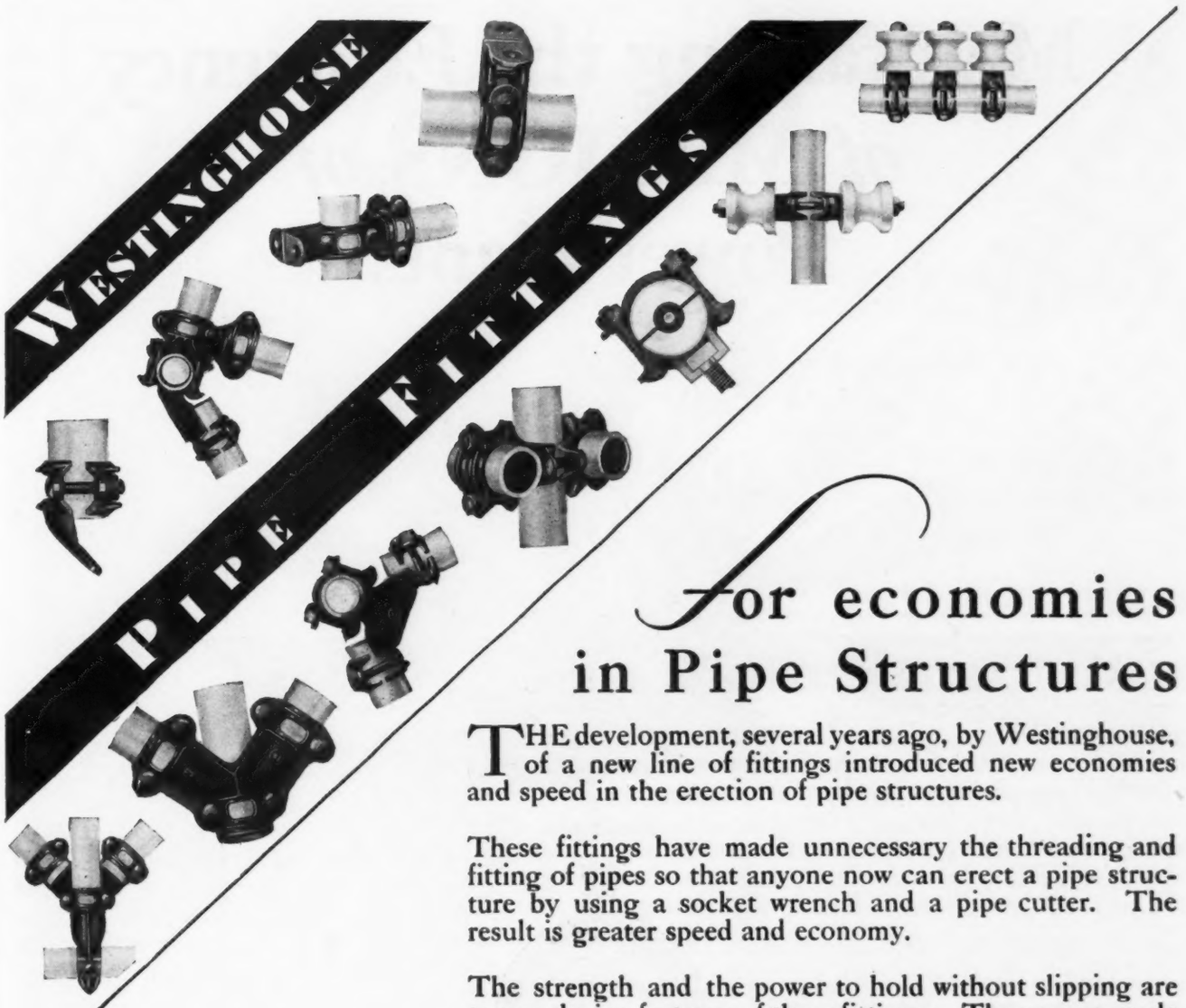


A 37,000-volt distribution-type LV autovalve arrester

WESTINGHOUSE ELECTRIC & MFG. COMPANY
EAST PITTSBURGH PENNSYLVANIA
SALES OFFICES IN ALL PRINCIPAL CITIES OF THE UNITED STATES AND FOREIGN COUNTRIES

Westinghouse

T 30439



For economies in Pipe Structures

THE development, several years ago, by Westinghouse, of a new line of fittings introduced new economies and speed in the erection of pipe structures.

These fittings have made unnecessary the threading and fitting of pipes so that anyone now can erect a pipe structure by using a socket wrench and a pipe cutter. The result is greater speed and economy.

The strength and the power to hold without slipping are two exclusive features of these fittings. They are so made that the diameter across the tips of each fitting is slightly smaller than the pipe diameter. The result of this construction is a biting action of the tips which occurs when clamping bolts pull the fitting into place. Holding power, far superior to any other type of fittings, is thereby obtained. The ribbed construction of each fitting gives reserve strength to withstand severe strains.

No—you don't have to carry a large stock of these fittings to fill your needs. A stock of only 30 fittings will give more than 10,000 combinations.

Ask for circular 1676-A—it completely lists and describes these fittings.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
EAST PITTSBURGH PENNSYLVANIA
SALES OFFICES IN ALL PRINCIPAL CITIES

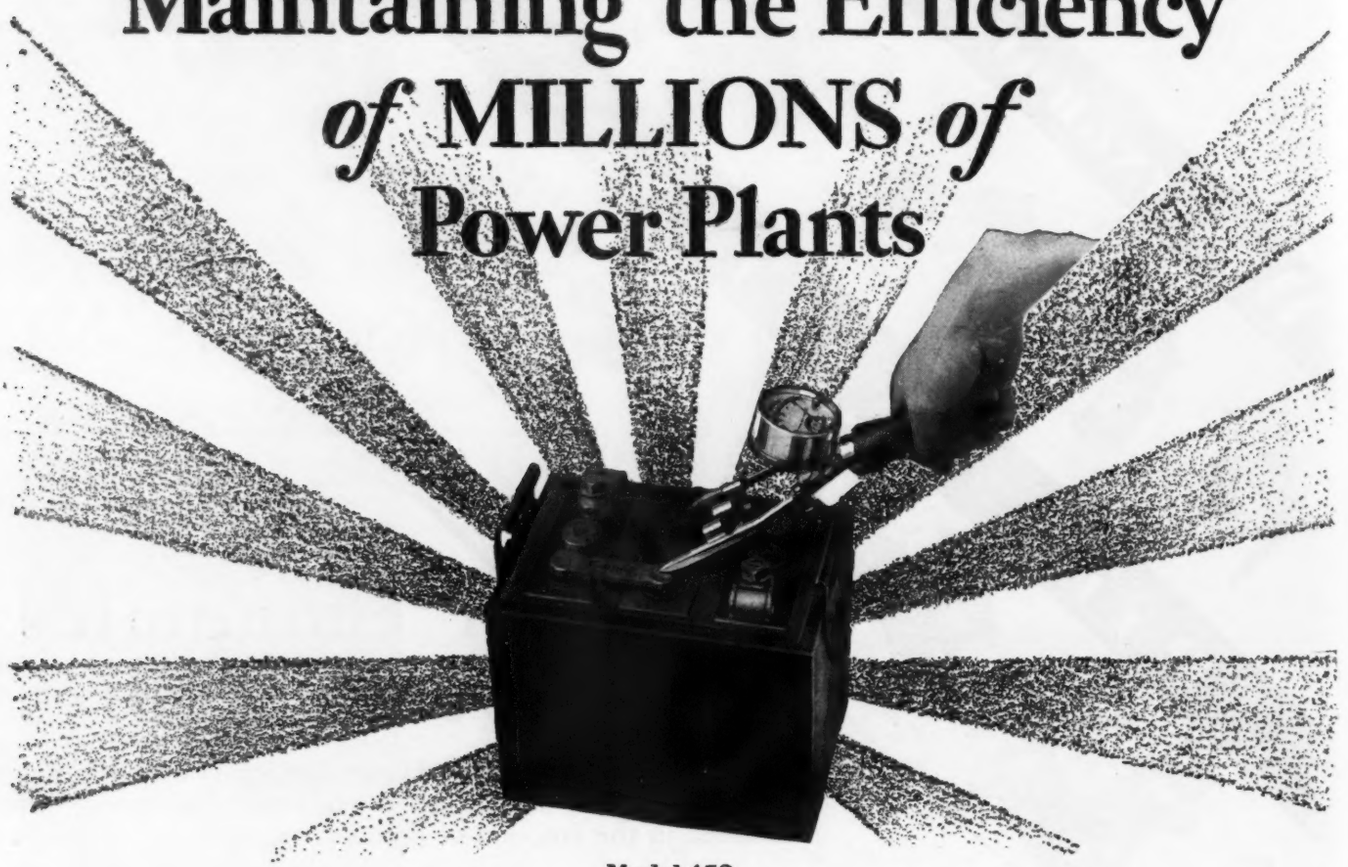
Westinghouse

T 30423

Other Switchboard Devices

Bus-bar supports
Adjustable inserts
Carbon circuit-breakers
Oil circuit-breakers
Steel panels
Indicating lamps
Disconnecting switches
Rotary switches
(Our 1928-30 Catalogue contains complete information.)

Maintaining the Efficiency *of* MILLIONS *of* Power Plants



Model 453

BATTERIES are the power plants of millions of small transmission and distribution systems—incalculably important to industry and commerce—*small* only in the sense of their individual output—comparable even to the great central stations themselves in their aggregate service.

The storage battery has become a necessary part of modern transportation and communication apparatus—the automobile, the motor bus and the electric railway, as well as the telephone and telegraph now employ these power units for an important source of supply.

Thus it is apparent that electrical measuring instruments—indispensable factors in maintaining continuous and efficient service of large generating systems—are also vitally necessary to the routine inspection and efficient maintenance of the nation's battery service.

Model 443

Weston offers two convenient and reliable instruments especially designed and mounted for use in storage battery testing. Like all "Westons", these meters are remarkably sensitive and exquisitely made.

Weston instruments the world over are the accepted standards of the electrical measuring art, and these two models are in all respects worthy of the famous name. They are durable, dependable, good for a life-time, and yet are moderately priced.

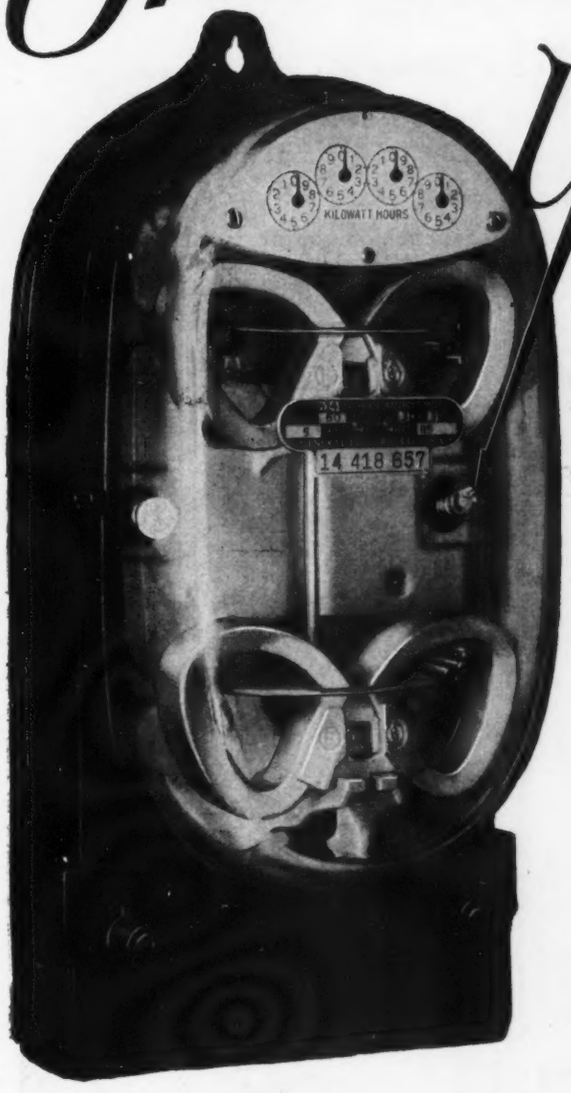
Model 443 for testing individual cells of storage batteries. Range, 0.2-0-3 volts. Accuracy, 2%. Size, 7x3x1¼ inches. Weight, only 8 ounces.

Weston
PIONEERS SINCE 1888
INSTRUMENTS
WESTON ELECTRICAL INSTRUMENT CORPORATION
578 Frelinghuysen Avenue, Newark, N. J.

Model 453 indicates the actual condition of storage batteries by giving the voltage when about 200 amperes flow through the prod. Size, 12 x 4 x 3¾ inches. Weight, 1¼ pounds. Accuracy, 2%.

One lamp is "out"!

Your warning against loss of revenue



Two little lamps are installed in G-E polyphase watthour meters to give warning when one of the meter elements is not registering.

Each lamp normally glows with current induced in an auxiliary coil placed around a potential coil of the meter. If one lamp shows "out", the meter reader reports it, and the installation is immediately inspected, *because*—

This condition—one element dead—causes the meter to read "low" and means a loss of revenue to the power company. Many such experiences are matters of record.

Therefore, this provision is an important feature of G-E polyphase meters. Take advantage of it by specifying "potential-indicating lamps" on your next order and thereby safeguard your company against any losses from this cause.

The line of G-E watthour meters, recognized for their high standard of long-range accuracy, is constantly being added to and improved. The simple but important feature mentioned here is typical of the new developments in G-E meter engineering.

600-13

GENERAL ELECTRIC

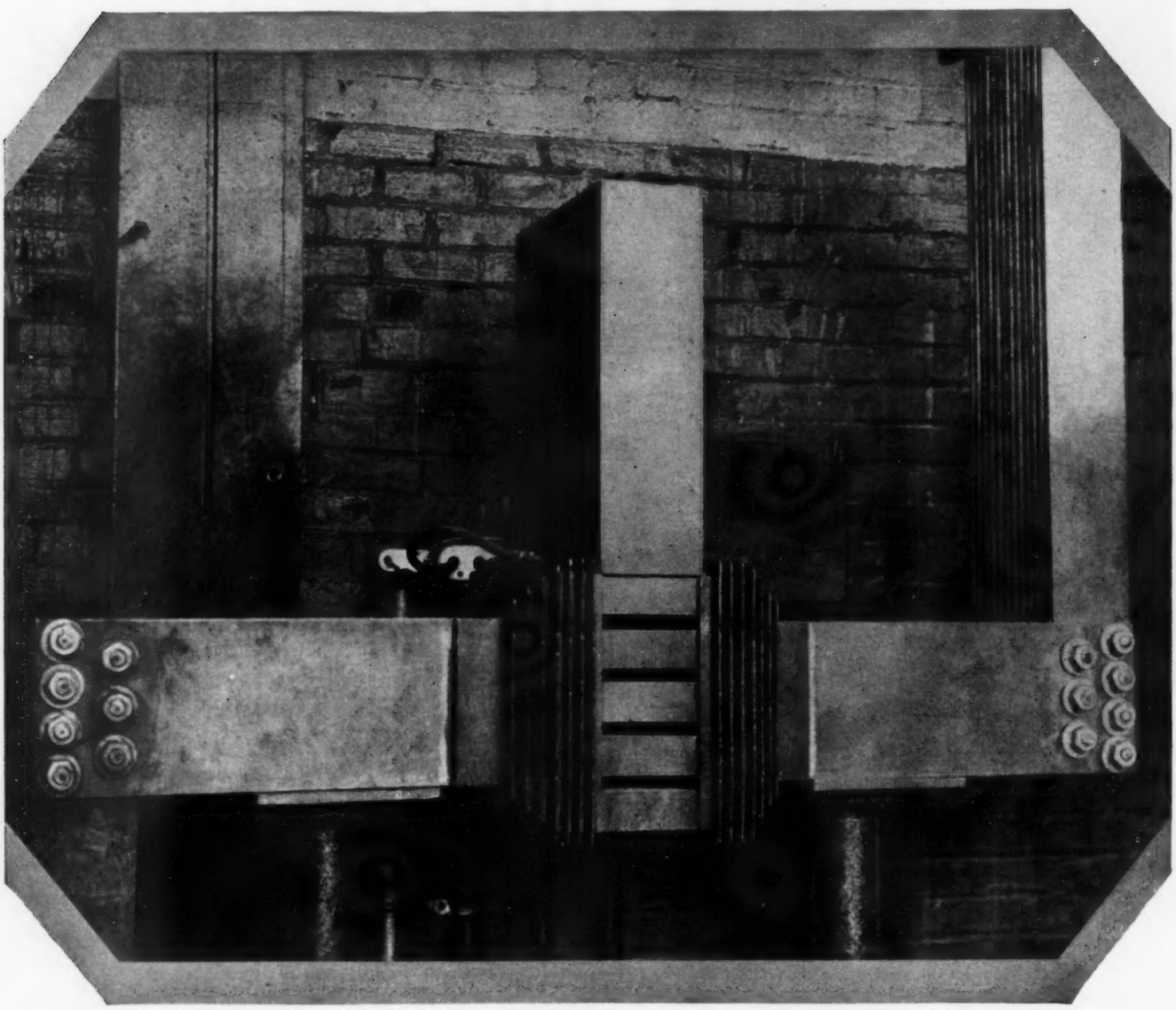
GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

40,000 AMPERE SHUNT

Sixteen years ago Sangamo made the famous 60,000-ampere shunt *in four 15,000-ampere sections* for the Niagara Falls plant of the Aluminum Company of America; now surpassed by a *single unit* 40,000-ampere shunt for the same company.

The first shunt has 50 m.v. drop at full load; the full load loss of 3 k.w. dissipated by immersion in oil. The latest one, weighing 2,650 lb., has 100 m.v. drop, and the 4 k.w. loss at full load is dissipated by internal radiating ducts, and external copper flanges aided by convection through a tall Bakelite chimney.

Another evidence of Sangamo ability to meet most unusual problems of measurement.

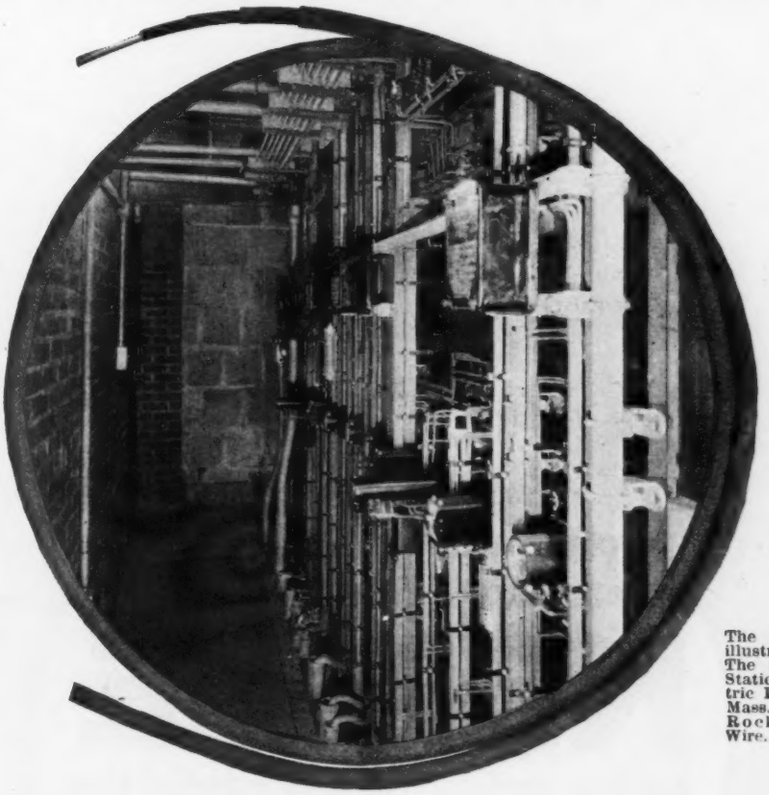


SANGAMO

ELECTRIC COMPANY • • • SPRINGFIELD, ILLINOIS 6431-3

ROCKBESTOS

-the asbestos insulated wire



The Switchboard in the illustration is installed in The Humboldt Avenue Sub Station of the Edison Electric Illuminating Co., Boston, Mass., and is wired with Rockbestos Switchboard Wire.

Switchboard Wire

LIGHTS are burning thruout the Rockbestos plant at night.

We are working night and day to turn out our new switchboard wire.

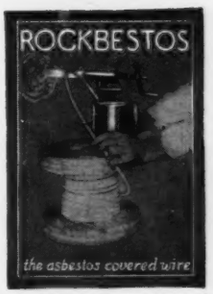
Central Stations and industrial plants everywhere are demanding this Rockbestos Switchboard wire because there has been a definite need for a really fine wire like this.

The Rockbestos wall of felted asbestos is our own idea. It gives absolute fire protection and has a mechanical strength not possible in any other wire.

Best of all, this switchboard wire makes a beautiful appearance when the job is done, because it can be bent into any shape without cracking or breaking the insulation.

No matter what you are using now, just send for a sample of Rockbestos Switchboard wire.

Test it by bending, examine carefully the insulation, then send us your requirements for prices.



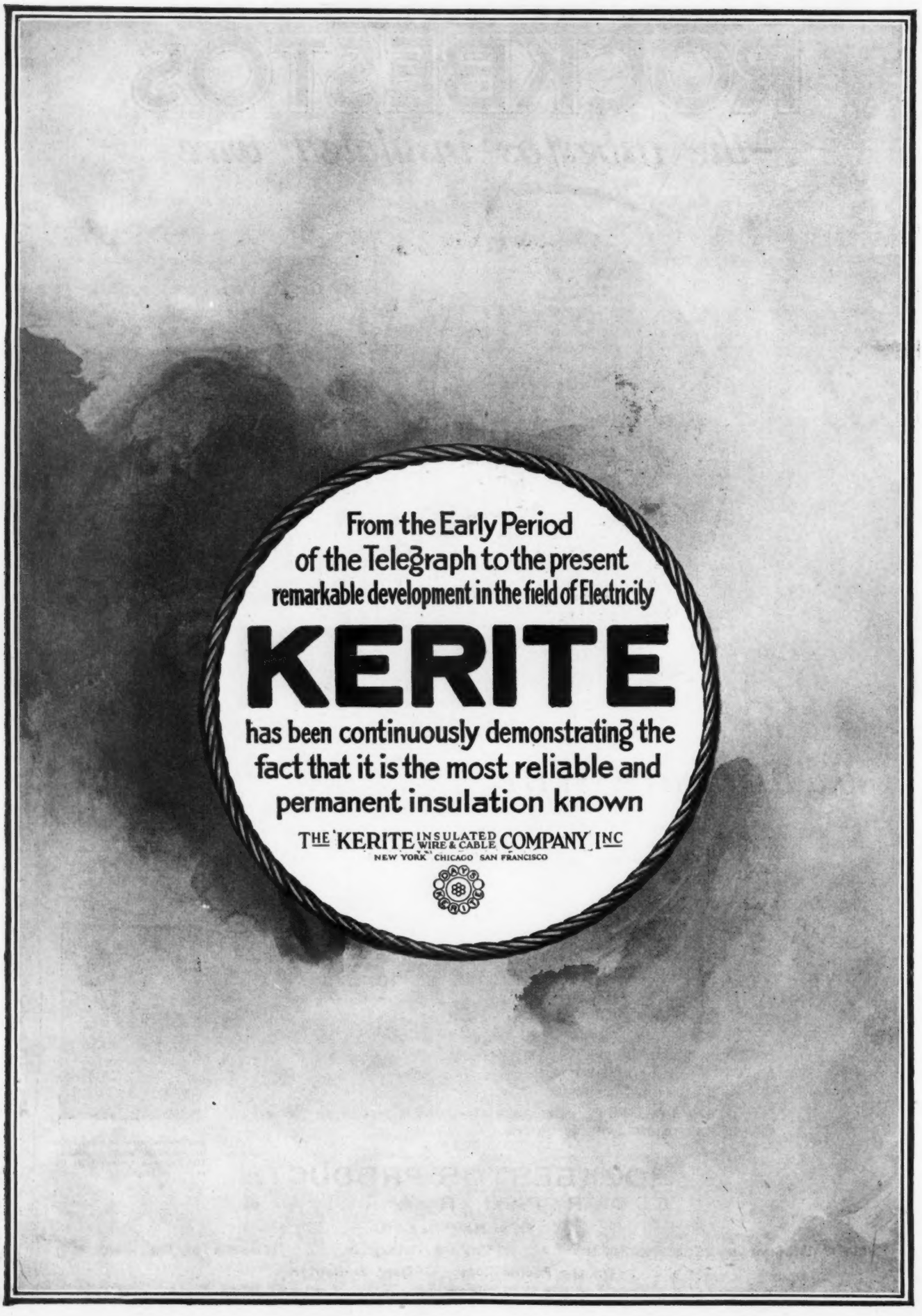
Bulletins covering switchboard wire and all other Rockbestos wires, will be sent on request.

ROCKBESTOS PRODUCTS CORPORATION

NEW HAVEN, CONN.

5942 Grand Central Term. Bldg., New York 903 Clark Bldg., Pittsburgh, Pa. 224 Madison Term. Bldg., Chicago

On the Pacific Coast—C. Dent Slaughter


From the Early Period
of the Telegraph to the present
remarkable development in the field of Electricity
KERITE
has been continuously demonstrating the
fact that it is the most reliable and
permanent insulation known
THE KERITE INSULATED WIRE & CABLE COMPANY INC
NEW YORK CHICAGO SAN FRANCISCO

250,000 Shares

Electric Bond and Share Company

Cumulative $6 Preferred Stock

Dividends Free from Present Normal Federal Income Tax

Callable as a whole or in part upon 30 days' notice at any time at $110 per share and accrued dividends, upon affirmative vote of a majority of outstanding Common Stock. Dividends are payable quarterly, February 1, May 1, August 1 and November 1.

For further particulars concerning the Company and its Cumulative $6 Preferred Stock, we refer to the letter of Mr. C. E. Groesbeck, President of the Company, which we summarize as follows:

Business Electric Bond and Share Company, a consolidation, effective March 13, 1929, of a company of the same name and Electric Bond and Share Securities Corporation, acts in a supervisory capacity for a large number of power and light and other public utility companies and supplies technical and financial assistance in connection with the financing, the business development and operation of these companies and the construction of their properties. It owns various amounts of stock of public utility holding companies, but controls only the American & Foreign Power Company, Inc., which controls directly or indirectly public utility subsidiaries operating exclusively in foreign countries.

Earnings Earnings for the twelve months ended February 28, 1929, as shown in the President's letter, were equal to more than **3¾ times** annual dividend requirements of $4,500,000 on all Preferred Stock to be outstanding upon completion of this financing and after giving effect to the consolidation.

Dividend Record Dividends at the rate of 5% per annum were paid regularly on the Preferred Stock of the former Electric Bond and Share Company from organization in 1905 up to October 31, 1911, at which time the regular rate was increased from 5% to 6% per annum, and such dividends were paid regularly at this rate thereafter to February 1, 1929, inclusive. Regular dividends (in addition to a number of special dividends) were paid on Common Stock of the former Electric Bond and Share Company from July 15, 1909, to March 8, 1929, inclusive. Dividends were likewise paid at regular intervals on the Common Stock of Electric Bond and Share Securities Corporation since its organization in 1925.

Equity The 750,000 shares of Preferred Stock presently to be outstanding will be followed by 9,615,306 shares of Common Stock of no par value, having a present market value of over $750,000,000.

Legal matters in connection with the issuance of this Preferred Stock will be passed upon by Messrs. Winthrop, Stimson, Putnam & Roberts of New York.

This Preferred Stock is offered when, as and if issued and received by us and subject to approval of counsel

at $106 per share and accrued dividends, to yield 5.66%

Bonbright & Company

Incorporated

25 Nassau Street New York

Chicago Boston Philadelphia Detroit St. Louis San Francisco

The information contained in this advertisement has been obtained from sources which we consider reliable. While not guaranteed, it is accepted by us as accurate.

ONCE MORE

the breakers

ONCE more the gleaming sands, the Boardwalk, June and the annual Convention of the National Electric Light Association in Atlantic City.....

Here in one crowded week the executives and engineers of the electric light and power companies of the country come to discuss their common problems. They come to view the exhibits of manufacturers who sell to this $854,000,000 market . . . (electric light and power companies will spend this much money in 1929 for new construction and equipment).

From the manufacturer's point of view this is a period when contacts are searched for.

And in this search the "N. E. L. A. Convention" number of *Electrical World*, published May 25th, leads off.

A week before the Convention opens, the delegates (the men you hope to contact through your exhibit) get the Convention keynote from this issue—opportunity No. 1 for contact.

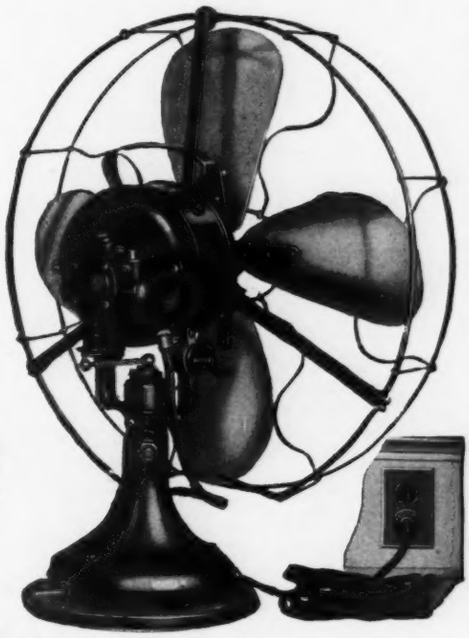
Then the Convention exhibit—opportunity No. 2.

Then the "Convention Report" number, published June 8th, the day after the Convention closes—opportunity No. 3 for contact.

Whether or not you exhibit, may we suggest an early reservation of advertising space in these two important issues?

Electrical World, a McGraw-Hill publication, Tenth Avenue at 36th Street, New York City
Member of the ABC and ABP

Photo Ewing Galloway



Century 16-in. 3-speed Portable Oscillating Fan A. C. and D. C.

Comfort

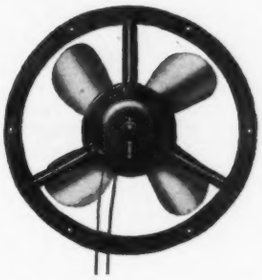
Correct Air Movement....A Selling Feature

When you sell a Century 16-in. 3-Speed Oscillating Fan, you sell continuous *Comfort*. They move an unusually large volume of air over wide areas because of a properly designed blade and an exceptionally slow oscillating speed. The air movement can be easily adjusted to the desires of the user.

The *Convenience* of Century Fans is emphasized by their ease of adjustment, their light weight, and a carrying handle securely attached to the top of the motor frame.

Their *Construction* assures lifetime service. The motor is fully enclosed, excluding dust, dirt and moisture. Bearings are machined from phosphor bronze castings—the best bearing material obtainable.

Century 60-in. Ceiling Fan for A.C. & D.C.



Century 16-in. Ventilating Fan for A.C. & D.C.

Century Fans Build Business

The Century Fan Line Includes

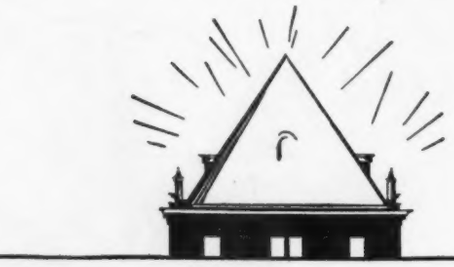
Portable. . . 9-inch, 12-inch & 16-inch oscillating 3-speed, Induction-type A. C. & series-wound D. C.
Portable. . . 9-inch oscillating, 1-speed, with switch in base, Induction-type A. C.
Portable . . . 9-inch stationary, 1-speed, with switch in base, Induction-type A. C.
Ceiling . .. 36-inch sweep, 4-blade, 3-speed, Induction-type A. C.
Ceiling . . . 60-inch sweep, 4-blade, 3-speed, Induction-type A. C. and series-wound D. C.
Ventilator . 16-inch, 3-speed, Induction-type A. C. and series-wound D. C.

CENTURY ELECTRIC COMPANY
1806 Pine St. St. Louis, Mo.

Century Fans are built by the Manufacturers of the Famous Century Motors

Century FANS

40 U. S. and Canadian Stock Points and More Than 50 Outside Thereof



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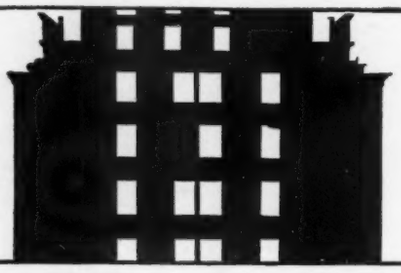

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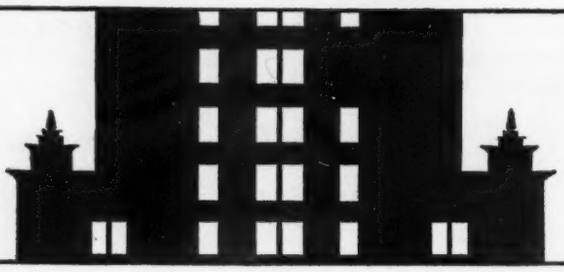

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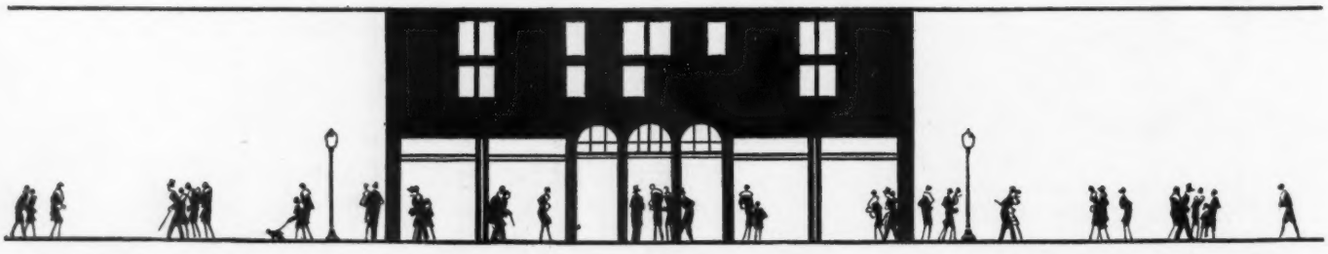

MENTION anything electrical that goes into any building anywhere, and you've named a Graybar item . . . More than that. You've named an item that is available to you on quick demand through a nationwide distributing service which conserves not only your time but your need for excessive reserve stocks . . . You've named one of Graybar's 60,000 items . . . Graybar Electric Co., Executive Offices: Graybar Building, Lexington Avenue and 43rd Street, New York, N. Y. Offices in 71 Principal Cities.

GraybaR

Successor to *Western Electric* Supply Dept.

THE GRAYBAR TAG—SYMBOL OF DISTRIBUTION

2513
What a Splendid Idea!
Where DID You Get that Numbered Porch Light?
The O. P. S. Man Will Bring It to Your Door
We'll Put it Up For You
The OHIO PUBLIC SERVICE Co.
Subsidiary of Cities Service Co.
Advertisement No. 4
Now You can have a LIGHTED HOUSE NUMBER and a Porch Light too!
This Modern Light both Marks and Guards Your Home

A New Thought
for Increasing Your Lighting Load

NEARLY two thousand "Illuminated Porch Lights" were sold in two weeks by the Ohio Public Service Company. This successful activity not only resulted in a merchandise profit but, due to long burning hours, there accrues a perpetual revenue increase to the company.

Your customers will eagerly accept this illuminated porch light—not only as a welcome beacon to friends and visitors—but as a guardian against thieves and prowlers.

The lighting field is ever expanding. It is ideas such as this—new and practical—that will enable *your* company to get the greatest return from its most profitable load—the lighting load. For information on the Illuminated House Number campaign, write the Sales Promotion Department, National Lamp Works of General Electric Company, Nela Park, Cleveland, Ohio.

NATIONAL

MAZDA LAMPS

MAZDA- the mark of a Research Service ...

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Incorporated
AMBURSEN DAMS
Hydro-electric Developments
Water Supply and Irrigation Dams
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Grand Central Terminals, New York.
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Tests of Electrical Machinery, Apparatus and supplies, Materials of Construction, Coal, Paper, etc. Inspection of Material and Apparatus at Manufactories.
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15 Park Row, New York

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Utility and Industrial Valuations. Design and Construction of Power Systems, Water Supplies, Sewerage and Sewage Disposal.
11 Park Place, New York City
Albany, N. Y. Atlanta, Ga.

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The solution to your problem of greater economy—

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The varied experience of a consulting engineer coupled with your particular knowledge of your business, makes for a quicker and more effective solution of your operating problems.

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E.W.

POSITIONS VACANT

A company manufacturing a complete line of high-tension equipment is looking for district managers and sales agents acquainted with the Dallas, Texas, Cleveland, Ohio and Cincinnati, Ohio territories. Line is complete, in successful operation on lines of some of the largest syndicates. Man must be acquainted with electrical apparatus and have had successful selling experience. Possibly man with other electric products calling upon central stations could qualify. A very substantial income can be obtained through the sale of this product. P-16, Electrical World, 7 South Dearborn St., Chicago, Ill.

A MANUFACTURER of high-quality control apparatus has openings for several 1927-8 electrical engineering graduates for sales, engineering, and research departments. Your application should indicate line of work preferred. P-11, Electrical World, 7 So. Dearborn Street, Chicago, Ill.

DESIGN engineers—large concern manufacturing automotive electrical equipment requires first-class designing engineers experienced in the design, for manufacturing in large quantity production, of small motors, generators, switches, clocks, speedometers, or similar apparatus. Give full details regarding age, education, experience and salary desired. P. O. Box 1027, Rochester, N. Y.

ELECTRICAL laboratory engineer to do research and design on illumination for municipality. Must be graduate electrical engineer and have two years' experience in electrical and photometric laboratory work and illumination design, or four years' experience if not a graduate. Civil service examination April 16th. Apply immediately to City Service Commission, City Hall, Milwaukee, Wisconsin.

ELECTRIC railway in central west can use young electrical engineer, who has had some experience on electric railway work; work would involve both theory and practice; position permanent, with chance for advancement; give full information in first letter. P-989, Electrical World, 7 So. Dearborn St., Chicago, Ill.

ELECTRICAL maintenance man wanted for large copper property in South America: Applicant must have had experience in electric shop work and armature winding. Three year contract, good living and working conditions, all traveling expenses paid. Applicant should state fully experience, married or single, age and when available. Address "C. P." Post Office Box 822, City Hall Station, New York City.

WANTED

METER TESTER

State Full Particulars and Salary Expected.

P-8, Electrical World
Tenth Ave. at 36th St., New York City

GOOD JOBS OPEN

Central stations must have meter experts. Hundreds of competent men wanted for positions paying $3,000 and over. We can train YOU at home in your spare time.

BE A METER ENGINEER

A postcard brings full details. No obligation.

FT. WAYNE CORRESPONDENCE SCHOOL
Dept. C., Ft. Wayne, Ind.

POSITIONS VACANT

ELECTRICAL design engineer, under 35 years, graduate preferred. Must have thorough grounding in fundamentals of electricity. Good personality. Location, East. Write full details of experience. P-2, Electrical World, Tenth Ave. at 36th Street, New York.

GRADUATE electrical engineer with experience in substation design, power plant wiring layouts, and general electrical design in connection with electric utility construction and operation; location near Kansas City; give age, nationality, education, degrees held, experience in detail and salary desired; furnish photograph; good opening for right man with opportunities for advancement. P-985, Electrical World, 7 South Dearborn St., Chicago, Ill.

FIRST-CLASS electricians wanted for steel substation construction and electrical work in power houses in Middle West. P-14, Electrical World, 7 So. Dearborn Street, Chicago, Ill.

MECHANICAL engineer. New England utility requires technical graduate, eight or ten years' experience in heating, ventilating and central station heating plant problems. General experience in steam power plant design and construction for public utility also desirable. In reply give education, complete experience and salary desired. Address P. O. Box 305, Essex Sta., Boston, Mass.

MECHANICAL and electrical draftsmen, technical education or equivalent in layout and design experience, by General Electric Company at Schenectady, N. Y. Apply Industrial Service Department.

WANTED: By a large electrical manufacturing company, an engineer who is familiar with the design of watthour meters and current and voltage transformers. Permanent position for the right man. State qualifications fully in reply to this advertisement. Also state salary expected. P-13, Electrical World, Tenth Ave. at 36th Street, New York.

WANTED—Meter engineer to take charge of standardization work in meter laboratory of large utility. Broad knowledge of construction of meters and instruments; ability to grasp problems and get work completed; and technical education are essential. Good opportunity for capable man. Apply P-17, Electrical World, Tenth Ave. at 36th St., New York.

EMPLOYMENT SERVICE

IF YOU are qualified for position between $2,500 and $25,000, and are receptive to negotiations for new connection, your response to this announcement is invited. The undersigned provides a thoroughly organized service, established nineteen years ago, to conduct confidential preliminaries, and assist the qualified man in locating the particular position he desires. Not a registration bureau. Retaining fee protected by refund provision, as stipulated in our agreement. Send name and address only for description of service. R. W. Bixby, Inc., 262 Main Street, Buffalo, N. Y.

$3,000-$30,000 men find our service effective in making connections individual. Confidential. Refund agreement. Not agency. Jacob Penn, Incorporated, 9 Park Place, New York.

POSITIONS WANTED

CONSTRUCTION foreman: Twelve years' experience, steel tower line, substations and distribution. PW-1000, Electrical World, Tenth Ave. at 36th St., New York.

ASSISTANT superintendent or general foreman of electrical construction; 18 years' of successful experience with large Eastern public utility companies. Constructing and reconstructing stations, underground transmission and distribution systems, including service work. Nearing completion of construction program. Will be available in April. Age 40. Initiative, organizer. Reference. PW-15, Electrical World, Tenth Ave. at 36th Street, New York.

A GRADUATE electrical engineer with 18 years' sales and construction experience, is open for connection. Large utility acquaintance and successful salesman; formerly sales manager for creosoting company; have specialized on cedar and pine poles for past six years. PW-3, Electrical World, Tenth Ave. at 36th St., New York.

CHIEF electrician wishes permanent position, maintenance or construction; 16 years' experience—references on request. PW-12, Electrical World, 7 So. Dearborn Street, Chicago, Ill.

ELECTRICAL estimator, superintendent, engineer, 25 years' practical experience on all classes of work. Philadelphia or New York and vicinity, Philadelphia preferred. PW-993, Electrical World, Tenth Ave. at 36th St., New York.

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2—300 kw., 125 v., 1200 r.p.m. New G.E. Synchronous motor sets, 3 ph., 60 cy., 480-2300 v.

1—200 kw. 1200 r.p.m., 250 v., G.E. New Synchronous motor, 3 ph., 60 cy., 480-2300 v.

1—150 kw., 600 r.p.m., 250 v., Gen., 3 ph., 60 cy. 220-440 v., G.E. Synchronous motor.

1—125 kw., 250 v. Westinghouse Synchronous Gen. Motor Set, 3 ph. 60 cy. 230/2200 v.

1—100 kw., 125 v., D.C. 220-440 A.C., G.E. Synchronous Motor Generator Set, 220/440 v.

1—100 kw., 250 v., Gen., 900 r.p.m., 2200 Synchronous Motor.

1—75 kw., 250 v., Generator, 3 ph., 60 cy., 2200 v., Synchronous Motor.

1—60 kw., 125 v., C.W., 3 ph., 60 cy., 220-440 v., Motor.

1—50 kw., 250 v., Westinghouse 2 ph., 60 cy., 220-440 v.

10-20-25-40 kw., 125 v., Exciter Sets.

10-20-30 kw. Balancer Sets.

3—5 kw. Battery Charging Sets.

ENGINE GENERATOR SETS AND TURBINES

1—937 kva., 750 kw. 8 P.F. 3ph. 60 cy., 480 volts. 3600 R.P.M. Gen. Elec. with d. c. exciter.

1—325 k.v.a.3 ph., 60 cy., 240-480 v.,G.E. Skinner Uniflow Engine Set.

1—150 k.v.a. G.E. Skinner Uniflow Set, 3 ph., 60 cy., 480-2300 v.

1—75 k.v.a. 3 ph., 60 cy. Westinghouse Geared Non-Condensing Turbine.

TRANSFORMERS

2—1500/3000 kva. G. E. combined oil and water cooled 3 ph., 60 cy., 11000-2200-2300 v.

3—150 kw., 4150 v., 120-240 Pittsburgh Oil Cooled Transformers.

15—5 kw., 30 kw., 3 ph., Pole Type, 2200-1100 440-220-110 G.E.

A. C. GENERATORS

No.	Kw.	Rpm.	Volts	Ph.	Type
1	400	360	480	3	G.E. "B"
1	250	600	440	3	Westg.
2	125	900	2300	3	Cr.-Wh.
2	100	900	230/2300	3	G. E.
1	75	600	220	3	Westg.
1	75	900	2300	3	G. E.
1	50	1200	220-440	3	G. E.
1	50	1200	2300	3	G. E.
1	30	1200	220-2200	3	G. E.

MOTORS—3 Phase, 60 Cycle

No.	H.P.	Rpm.	Volts	Type
1	600	360	440	G. E.
1	500	600	2200/4150	G. E. syn.
1	400	450	2200	G. E. syn.
1	250	600	220/440	Westg. syn.
1	250	600	440/2200	G. E. syn.
3	200	514	4150/2300	G. E. syn.
1	150	900	2300	G. E. syn.
4	150	514	2200	Westg. sl.rg.
1	150	1800	2200	Westg. sq.cg. mtr.
1	100	900	440/2200	G. E. sq. cg.
1	100	900	220/440/2200	Westg. sq. cg.
1	75	600	220	G. E. sq. cg.
1	75	600	220	Fair.-M. sl. rg.
1	75	490	440	Allis-Chal. sl. rg.
1	75	900	2200	G. E. Kt.
1	60	1200	220	G. E. sl. rg.
1	60	720	220/440	G. E. Kt.
1	60	300	220/440/2300	Fair.-M. syn.
1	50	600	2200	G. E. MT sl. rg.
1	50	900	2200	G. E. B.
1	50	1200	220/440	Wagner sl. rg.
1	40	1700	220/440	Westg. sl. rg.
1	40	1200	220/440	G. E. KT.
1	25	900	440/2200	Cr.-Wheeler
1	25	1200	440	G. E. K.
1	25	900	220	Westg. C. S.

(2 Phase Motors on Request)

BRAND NEW MOTORS

No.	Hp.	Rpm.	Volts	Type
1	40	900	220-440	Gen. Electric KT
1	40	1200	220-440	Gen. Electric MT
2	30	1200	220-440	Gen. Electric KT
1	30	900	220-440	Gen. Electric KT
5	25	900	220-440	Gen. Electric KT
4	25	600	220-440	Gen. Electric KT
1	15	1200	220-440	Gen. Electric KT
2	15	1200	220-440	Gen. Electric MT
1	10	1200	220-440	Gen. Electric MT
5	7½	900	220-440	Gen. Electric MT

D C. Generators

No.	Kw.	Rpm.	Volts	Type
1	300	1200	125	brand new. G. E.
1	200	1200	250	brand new. G. E.
1	200	600	250	G.E.
1	150	600	250	G. E.
1	100	720	250	G. E.
1	75	450	250	Diehl
1	50	600	250	Westg.
1	30	1000	250	Westg.

(Smaller Sizes on Request)

D. C. MOTORS—230 VOLT

No.	Hp.	Rpm.	Type
1	250	550	G. E.
1	150	600	G. E.
1	150	1100	Westg. SK.
1	125	550	Cr.-Wheeler
1	100	625	Westg. Type S
1	80	500	Allis-Chal.
2	75	475	Westg. Type S
1	50	560	Westg. Sk
1	50	650	Sprague
1	40	400	Diehl
1	40	1300	Diehl
1	35	200	Diehl
1	35	700	Cr.-Wheeler
1	35	420	Diehl
1	20	665	Diehl
1	20	200	Diehl
1	20	900	Diehl

(Smaller Sizes on Request)

D. C. MOTORS—125 VOLT

No.	Hp.	Rpm.	Type
1	125	575	G. E.
1	100	600	G. E.
1	80	600	G. E.
3	25	1200	Sprague
1	20	650	G. E.
1	15	775	SK Westg.

POSITIONS WANTED

ELECTRICAL engineer, desires opportunity with utilities construction department. Experience supervision of plant substation transmission and distribution construction. Solicit investigation of activities and capabilities as construction and maintenance engineer. PW-977, Electrical World, Tenth Ave. at 36th St., New York.

ELECTRICAL engineer, 20 years' contact with utilities operations. Experience on design and planing central and substation, transmission and distribution. Resident engineer planning and construction. Desires opportunity in a subordinate or executive capacity in the construction division. PW-976, Electrical World, Tenth Ave. at 36th St., New York.

ENGINEER, mechanical, 27 years' practical experience, chiefly foreign countries, handling contracts sales installation inspection steam turbines and other machinery; willing to travel abroad. PW-991, Electrical World, Tenth Ave. at 36th St., New York.

METER tester, 8 years' experience, single and polyphase meters, switchboard and curve drawing instruments. PW-968, Electrical World, Tenth Ave. at 36th St., New York.

POSITIONS WANTED

ELECTRICAL ENGINEER, university graduate, 43, now employed, 2 years general electric test, 7 years electrification, including generation, distribution, motor applications with associate control, lighting, etc., as practiced by manufacturing plants, cement mills and other industries. Experience covers estimates, designs, layouts, requisitions for material and kindred subjects. Desires to correspond with large utility, manufacturing or industrial concern requiring a man with above qualifications. Capable taking charge of drafting department or supervising industrial installations and maintenance. PW-5, Electrical World, Tenth Ave. at 36th St., New York.

METER ENGINEER, desires position with responsibility, where knowledge of meter work is essential, has 15 years' experience in all branches of meter and instrument work, including 2 years as superintendent of meter department. PW-6, Electrical World, Tenth Ave. at 36th St., New York.

TECHNICAL graduate, '25, with four years' experience in construction and operation of electrical distribution system, desires connection with public utility. PW-10, Electrical World, 7 So. Dearborn Street, Chicago, Ill.

TRAINING for sales position with manufacturer of industrial electrical equipment. Graduate of M. I. T. 1926 in electrical engineering. Two and one-half years' experience in general engineering department of large power and light company. PW-986, Electrical World, 7 South Dearborn St., Chicago, Ill.

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Condensed course in electrical engineering; complete in one year; for men of character, ambition and limited time; theoretical principles and practical applications of electricity; mathematics, steam and gas engines, mechanical drawing, extensive shop work; construction, installation, testing; fireproof dormitories, dining hall, laboratories, shops; established in 1893; catalog on request. 253 Tacoma Ave., Washington, D. C.

U. S. Government

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., March 26, 1929.—Sealed proposals will be opened in this office at 3 p.m., April 8, 1929, for furnishing all labor and material necessary for the furnishing and installation of two electric freight elevators in the old appraisers stores (U. S. govt. warehouse), New York, N. Y. Drawings and specifications may be obtained at this office in the discretion of the supervising architect. JAS. A. WETMORE, Acting Supervising Architect.

Foreign Utility Executive

Broad gauged, well balanced, American trained, operating executive of sound experience in development and management of utility properties in Europe, Far East and So. America now available for connection with well financed organization operating in the foreign field. American, 35, Gentile, married, graduate engineer.

PW-10, Electrical World
Tenth Ave. at 36th St., New York City

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Sales Engineer

Man 1927 or 1928 graduate in electrical engineering who prefers the commercial side of a manufacturing organization and who is interested in traveling sales work. Make your answer a sales letter. This is a good opportunity to connect with a growing concern with offices in the principal cities. Location Middle West. SW-18, Electrical World, 7 So. Dearborn Street, Chicago, Ill.

WANTED

WANTED TO BUY

STEAM TURBINES

2—1,000 kw. or smaller non-condensing 15 lb. back pressure.

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Motors that save you money!

Gregory Hi-Grade-Rebuilding Processes make it possible for us to furnish you motors new in appearance, performance and lasting qualities, at a DECIDED SAVING IN PRICE.

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Your Choice
of Standard Makes of
Motors, Generators, Transformers, etc.,
at prices that show a real saving.

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Rebuilders of Hi-Grade Electrical Machinery Since 1893

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TRANSFORMER SALE

Every Working Day in the Year
30 to 60% Saving

———— Steel Co.
St. Louis, Mo.

The Electric Service Co., 212 Walnut St.,
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Gentlemen: In answer to your letter with regard to transformers you have furnished us, we are very well satisfied with them and wish to add have had no trouble. We are also pleased with the service you have given and you can rest assured that at any time we are in the market for anything of this kind we shall be glad to take the matter up with you.

Yours very truly,
———— Purchasing Agent.

We have 5,000 transformers in capacities from 1 to 1,000 kva. and 110 to 66,000 volts in stock. About one-half of them are brand new—all leading standard makes—and have never been in service. We purchased them by liquidation of public utility stocks preceding "change overs."

All used transformers have been thoroughly re-built by expert workmen in our own shops.

Every transformer we sell is tested to A.I.E.E. standard and is GUARANTEED by us.

Visit our shops—get our low prices.

We will also repair your broken down transformers—singly or in quantity lots—at substantial savings to you. Over 20 years' experience. Highest quality workmanhip. Investigate this money saving transformer maintenance service.

The ELECTRIC SERVICE CO. Inc.

America's Used Transformer Clearing House
212 Walnut Street Cincinnati, Ohio

We buy modern type transformers—any size—any quantity.
Specially interested in large size transformers in not less than carload lots.

HIGH GRADE STANDARD EQUIPMENT

Slip Ring Motors—3 Ph., 60 Cy.

Hp.	Volts	Make	Speed
400	2200-550	Whse.	450
225	220-440	G.E.	450
150	220-440	G.E.	720
150	220-440-550	G.E.	600
125	2200	G.E.	1200
125	220-440	G.E.	600
100	2200	G.E.	900
100	440-220	G.E.	720
100	440-220	G.E.	600
100	440-220	G.E.	900
75	220-440	G.E.	720
75	440-220	G.E.	900
75	550	G.E.	720
50	550	G.E.	514
50	220-440	G.E.	900

Synchronous Motors—3 Ph., 60 Cy.

Hp.	Volts	Make	Speed
240	2200-440	G.E.	720
135	2200-550	G.E.	900
80	2200-440-220	G.E.	1200
75	220-440	G.E.	900

Direct Current Motors

Hp.	Volts	Speed	Make	Type
225	230	760	Westghse.	SK
100	230	625	Westghse.	SK
60	230	1050	General Electric	RC
50	600	1450	Westghse.	SK

Direct Current Generators

200	250	850	Westghse.	SK
125	250	650	Western Electric	L
100	250	720	Westghse.	SK
75	250	850	General Electric	CLB
65	125	800	Westghse.	SK
35	125	850	General Electric	DLC
6	125	300	Westghse.	SK

Sq. Ca. Motors—3 Ph., 60 Cy.

200	2200	Westghse.	600
150	2200	Westghse.	720
100	550	G.E.	1800
100	220-440	G.E.	1800
100	220-440	G.E.	900
75	220-440	G.E.	900
75	220-440	G.E.	720
75	220-440	G.E.	1200
75	2200	Allis-Chal.	1200
50	220-440	G.E.	900
50	550	G.E.	900
40	220-440	G.E.	1200

Motor Generator Sets

1—200-kw., 250-275-v., 900-r.p.m., G. E. Type, D.M.C. connected to A.T.I., 2200-v., 3-ph., 60-cy., syn. motor.

1—100-kw., 125-v., 1200-r.p.m., G. E. Type MPC.; D.C. Generator connected to 125-kva. G. E. Type ATI, 440-220-v., 3-ph., 60-cy., syn. motor.

1—50-kw., 125-v., 1150-r.p.m. G. E. Type RC, D.C. Generator connected to 75 hp. G. E. Type KT, 220-440-v., 3-ph., 60-cy. motor.

1—50-kw., 125-v., 1150-r.p.m. Westghse, S.K. D.C. Generator connected to 75 hp. Westghse Type CS 2200-v., 3-ph., 60-cy. motor

A. C. Generators

1—187-kva., 720-r.p.m., 2200-440-220-v., 3-ph., 60-cy., G. E. belted exciter.

1—100-kw., 900-r.p.m., 2200-v., 3-ph., 60-cy., G. E. belted exciter.

1—75-kw., 900-r.p.m., 480-240-v., 3-ph. 60-cy G. E., belted exciter.

1—75 kw., 1200-r.p.m., 2200-480-240-v., 3-ph., 60 cy., G. E. belted exciter.

1—37 ½-kva., 1200-r.p.m., 240-v., 3-ph., 60- cy. G. E., direct connected exciter.

Transformers

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3—G. E.	200-kva., 60 cy.,	2300-230-115
2—G. E.	250-kva., 60 cy.,	2300-230-460

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150	G. E.	600	3	220	I.M.
100	Westghse.	600	3	550	C.W.
100	Allis-Chal.	600	3	440	ANY
100	Westghse.	580	2	220	C.W.
50	Allis-Chal.	720	3	220	ANY
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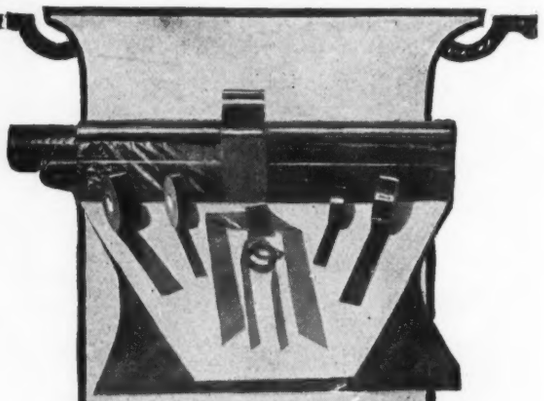

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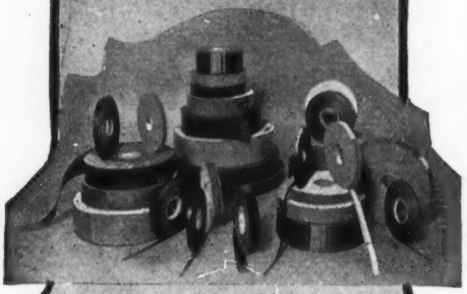

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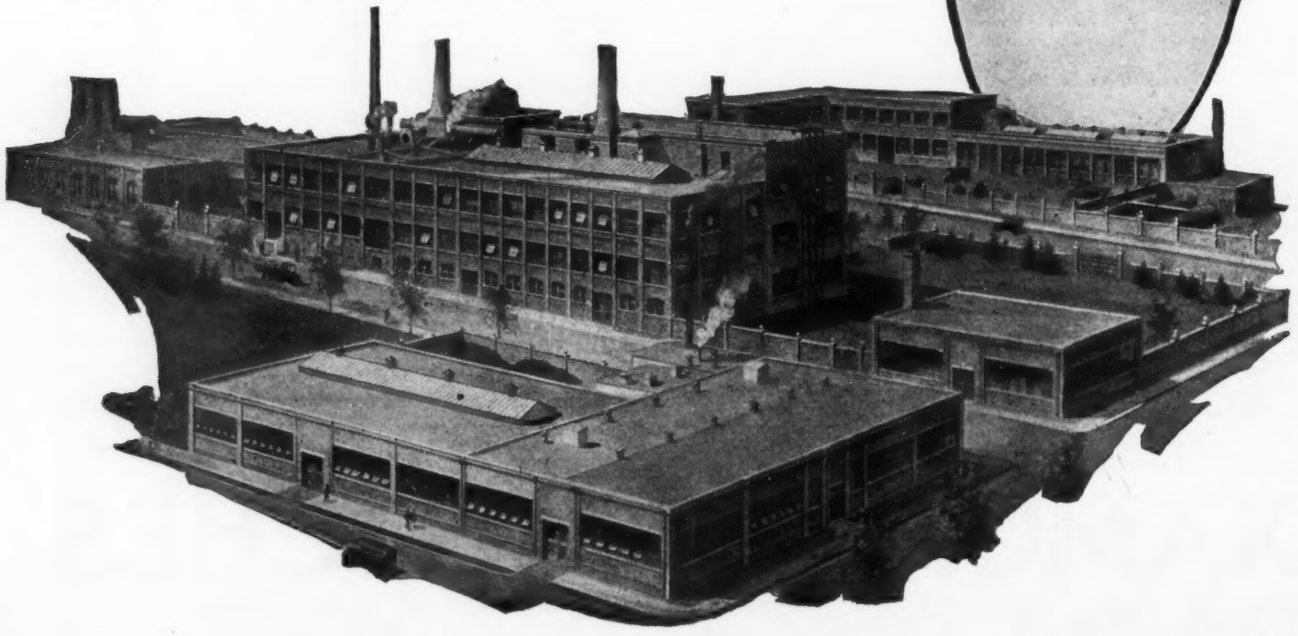

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AN AUTOMATIC, electrically-heated oven for the baking of small cores used in the manufacture of iron faucets or spigots for steel barrels has been used by the Steel Drum Accessories Corporation of Buffalo, N. Y., for more than a year. According to a statement appearing in a recent number of *Power Events*, the publication of the Buffalo, Niagara & Eastern Power Corporation, this installation has not only proved entirely satisfactory but has more than paid for itself during the first six or seven months of operation in saving of time and the elimination of labor and has also proved that with the use of electric heat, waste is almost negligible.

Cores are placed in trays which are rolled into the oven by an electrically controlled overhead trolley or conveyor system. The oven heat is brought to a temperature of from 450 to 550 deg. F. and is controlled by a thermostat. The air in the furnace is recirculated by the aid of an electric fan and the volume may be regulated.

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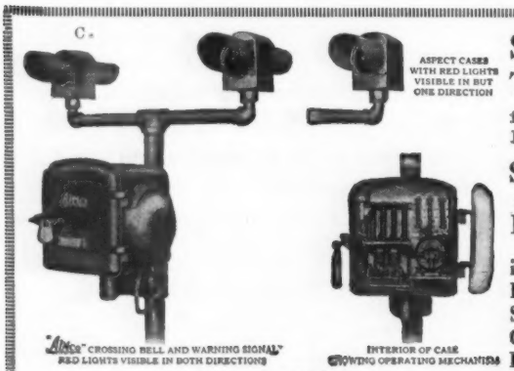
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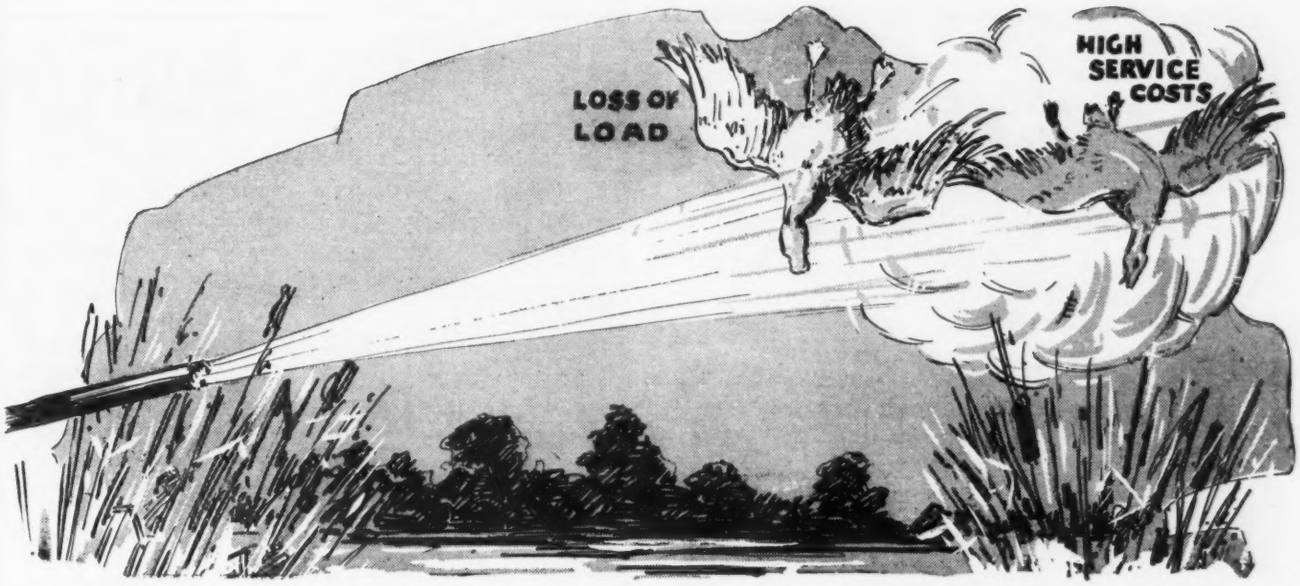

TIREX double barreled efficiency hits High Service Costs— Loss of Load

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FOR	FOR
Electric Grinders	Fans
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Killing these two birds with TIREX Portable Cord is the experience that hundreds of central station merchandising men have had according to what they say.

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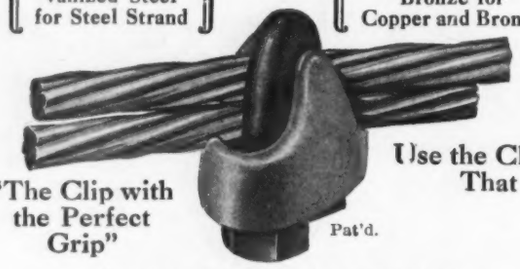

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Insulated Staples

Unequalled for telephone and bell wiring. The fibre insulation prevents troublesome short circuits and grounds. 4 sizes. Pat. Nov., 1900. Write for Samples.

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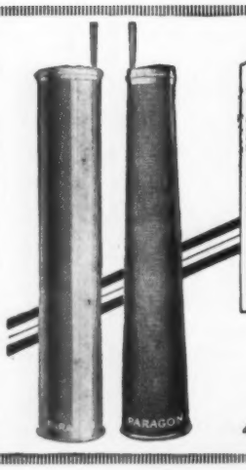

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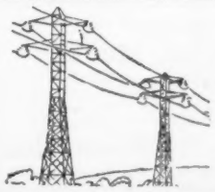

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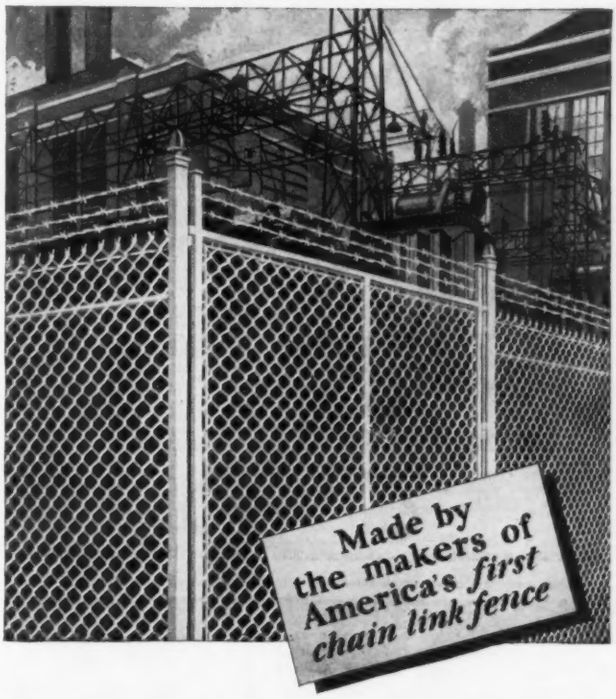

OUR 35 years' experience in manufacturing and erecting fences has resulted in special Anchor developments in construction which provide exceptional strength at every point in an Anchor Fence.

Near you is one of our 75 offices with an Anchor Fencing Specialist and trained erectors. Thru that office we place at your disposal all the facilities of our plants and engineers. You may obtain intelligent fencing advice and complete erection service by simply writing or phoning a local Anchor office. Our special Industrial Catalog will be sent upon request.

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EST. 1892

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Specially Shaped handles make more efficient workmen

Realizing the importance of tool handles to facilitate work, all Oshkosh handles are carefully and scientifically shaped. Workmen can grasp Oshkosh Tools easier and more firmly and use them for longer periods without tiring.

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The Cant Hook has small stop to prevent hook from falling back on handle and bruising the fingers.

Leading Jobbers carry Oshkosh Tools. Your Jobber can supply you.

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Gasoline—Kerosene

Especially designed to withstand the abuse of Splicing Service.
50 lbs. of solder melted in **10 minutes.**

But More Important—the length of time they will remain in the field, free from trouble common to the average furnace will surprise the most experienced user. We'll name Public Utilities with over **1,000 Unique** Furnaces in use.

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General Offices and Plants
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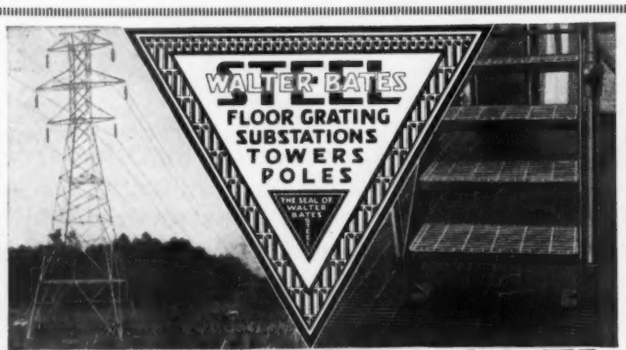

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The outstanding development in lightning protective apparatus.
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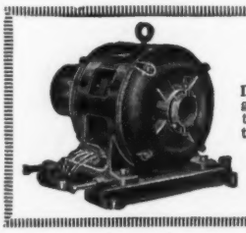

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A QUALITY PRODUCT
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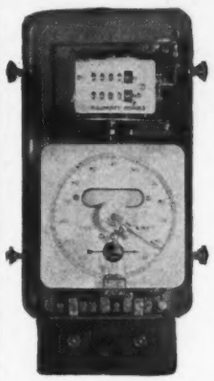

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with maximum demand indicator. Type FBodm

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may be more easily controlled from a distance when their position is transmitted back by means of Tanner Remote Indicators.

May we send you bulletins describing these indicators?

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Let us help increase your revenue
Detroit Electric Furnace Co.
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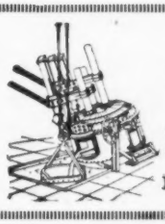

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Ten Standard Sizes ½ to 24 Tons Capacity
Most Rapid and efficient for making
Tool Steels, Alloy Steels, Forging Steels
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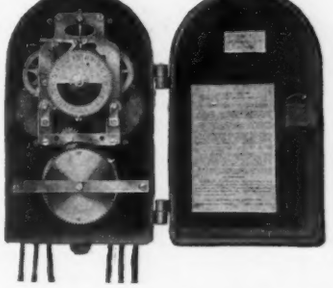

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All capacities
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20 to 30 years is the length of dependable service you can expect from a Hartford Time Switch. For every time switch need, there is a Hartford suited to the job. Marine type eight-day clock movement eliminates human forgetfulness, wasted current and inaccurate service.

Buy a switch that will pay for itself in service rendered—Buy a Hartford which assures the service you pay for.

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Just a teapot to his aunt —but a BIG IDEA to James Watt

FOR over an hour a frail, visionary youth sat engrossed with a steaming teapot. "Aren't you ashamed to waste your time so!" scolded his aunt. She saw a teapot—nothing more; Watt saw a teapot, and something else—*steam in industry.* And the world's industrial development made little headway until James Watt saw with the eyes of the pioneer.

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Today's business leaders are pioneers on a gigantic scale . . . pioneering with new conditions, new factors . . . pioneering with the vision of James Watt. Result: constant new developments in the realm of power. . . in silk, leather and paint . . . new methods . . . new machines . . . new legislation . . . new generations with emphatic new ideas . . . all business being affected by new, outside influences.

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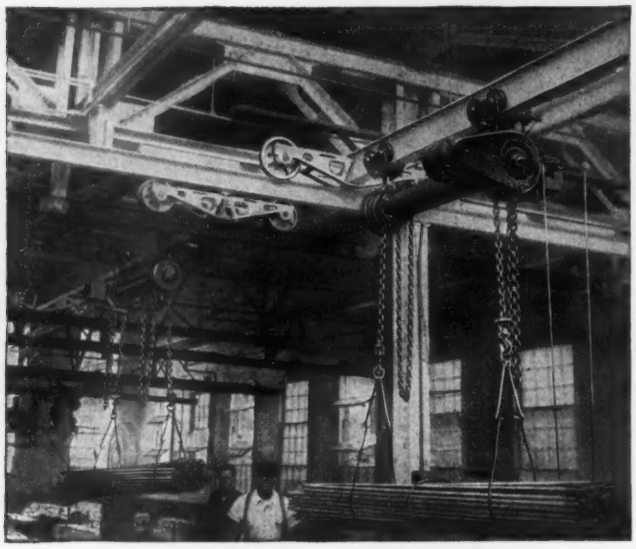
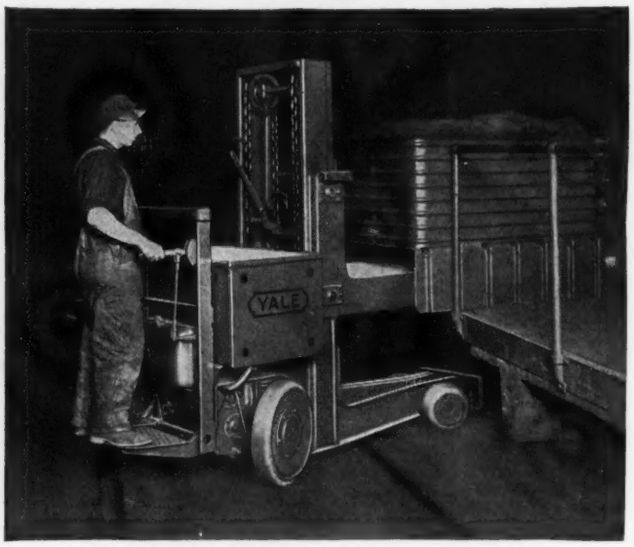
YALE HANDLES LOADS BETTER
YALE EQUIPMENT IS BEST



An Installation of Single I Beam Cranes with Electric Twin Hook Hoists



YALE K22 Elevating Platform Truck handling a metal box skid of castings

Co-ordinate your production through scientific handling of all materials and work in progress.

Our engineers have extensive practical experience gained in co-operating with many industries—an experience Yale makes available to every plant, but which no one plant alone could acquire.

Place your plant material handling problems in the hands of your man best equipped to co-ordinate your requirements on the basis of studied relations to work in progress. Discard haphazard and costly methods, and utilize Yale superior handling equipment. Yale offers you without cost expert consultation and affords you lowered production costs. Yale equipment will definitely pay for itself several times a year.

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Supplemental equipment such as skids, cranes, lifting forks, etc., imparts a great diversity of uses, and a great versatility to Yale Electric Industrial Trucks. Yale will definitely save you money, give you lowered costs and increased profits. Write today for details.

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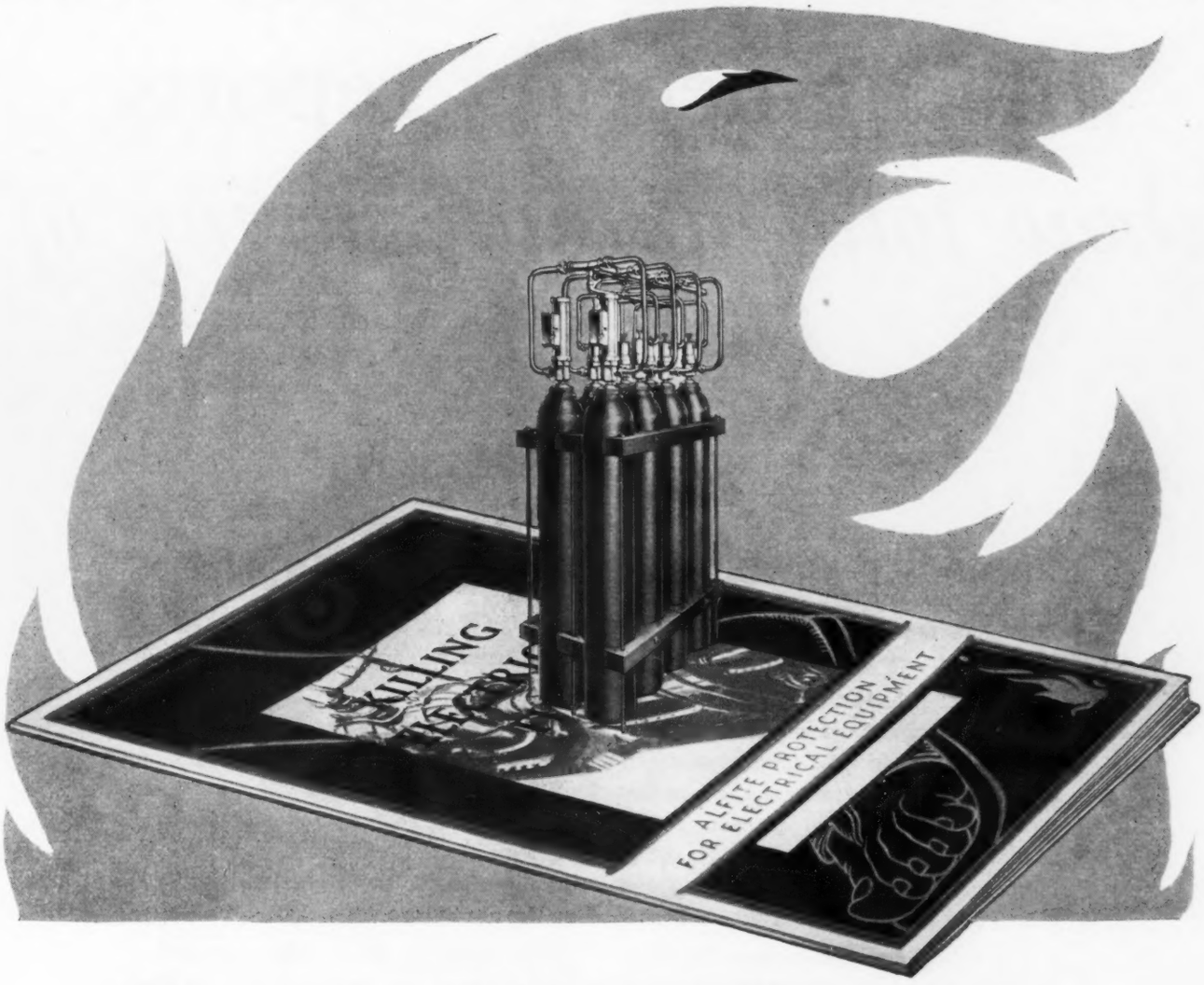
Hoisting and Conveying Systems

KILL FIRE WHILE IT IS YOUNG



The story of ALFITE Protection—told in this new booklet

Have you received your copy of "Killing Electrical Fires"? This booklet completely describes and illustrates the ALFITE System—the latest development in the protection of electrical equipment against fire.

It shows how the ALFITE System can be used to give instant and certain protection for either rotating or control equipment. It covers details of operation and the action of fire-killing ALFITE Gas.

No method has ever given such sure control of electrical fires as that offered by the ALFITE System. Its refinements and perfection are the result of years of study and experiment by both American-La France and Foamite fire control specialists and a group of engineers widely experienced in Central Station operation. The results of their work are described in "Killing Electrical Fires".

We will gladly send a free copy to anyone interested. Write Dept. N-18, American-La France and Foamite Corporation, Engineers and Manufacturers, Elmira, N. Y.

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Please send my copy of "Killing Electrical Fires"

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Company .....

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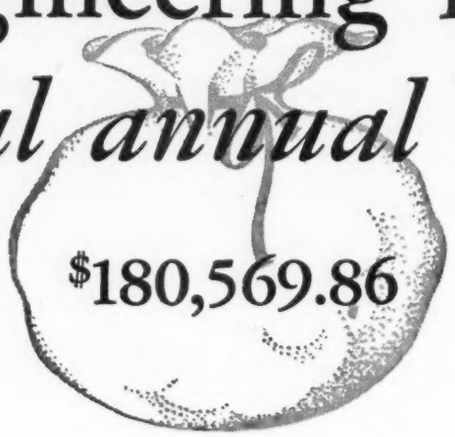
AMERICAN-LA FRANCE AND FOAMITE PROTECTION

A Complete Engineering Service
For Extinguishing Fires

61 engineering reports *show total annual saving of*



BROUGHT ABOUT BY CORRECT LUBRICATION

These reports were not taken *at random*. Here is how they were selected.

Out of the thousands of reports in our files that show savings, we chose one hundred good—but not exceptional—ones of recent date. Thirty-nine of this number showed the savings in percentages, so that we could not use them. We added up the cash savings mentioned in the others and they came to $180,569.86.

These sixty-one reports showed savings in terms of cash that range from $144 to $14,000 annually.

We have other reports showing savings considerably higher than these figures. These are not included in the above total because we wish to show average conditions in average plants.

These sixty-one operating economies were brought about through the installation of the most suitable Gargoyle lubricants and our lubricating methods. Through continued cooperation of Vacuum Oil Company Lubrication Engineers with the personnel of the plants, these economies were brought about and maintained.

This sort of work covers a great many details involving lubrication technique or equipment which may often seem of minor importance in each individual case, but, in terms of plant efficiency, their total is usually of major importance, as is proved by the above records.

The ways in which these economies were effected are listed briefly in the chart on the right.

During the coming year we will publish accounts of the more interesting of these reports. These accounts will tell in more or less detail where the economies were found and how they were brought about.

Possibly, as you glance over this chart, you will see possibilities for lubrication savings in your plant. If you would like to talk over the matter of lubrication with one of our engineers, he will be glad to call on you.

Here is what you should expect from your lubrication

Are you getting it now?

Possible Economies in:

1 Increased production.
2 Fewer shut-downs due to lubrication troubles.
3 Reduced power consumption.
4 Lower repair costs.
5 Lower rate of machinery depreciation.
6 Lower labor costs to apply lubricants.
7 Lower ultimate lubrication costs.
8 All-around greater plant efficiency.

The Vacuum Oil Company is particularly fitted to help you bring these economies about by virtue of:

(a) Sixty-three years of specialization in manufacture of high-grade lubricating oils.

(b) A world-wide force of 300 skilled Lubrication Engineers especially equipped to advise industry.

(c) The experience gained by more than 90,000 engineering visits a year to manufacturing plants in all industries.

(d) The most complete compendium of lubrication information in the world.

(e) The advice of a thoroughly experienced lubrication engineer who works in cooperation with your plant engineer or superintendent.

(f) A careful survey and analysis of mechanical equipment and operating conditions in your plant.

(g) A written report that specifies correct application of correct oils for efficient and economical operation of each engine and machine.

(h) Following acceptance of the recommendations made, a periodic engineering service will be given by qualified lubrication engineers. This service will follow a definite schedule and is for the purpose of seeing that the desired results, as outlined in the recommendations are actually secured in practice.

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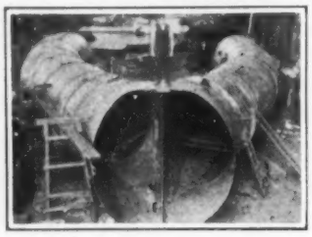
Headquarters: 61 BROADWAY, NEW YORK

Branches and distributing warehouses throughout the country

Lubricating Oils

The world's quality oils for plant lubrication.



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Riveted and welded

Hydro-Electric Division

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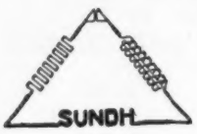

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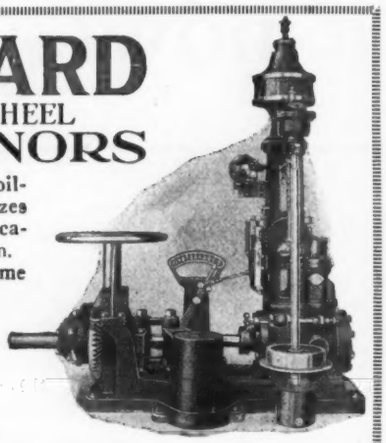

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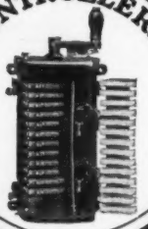

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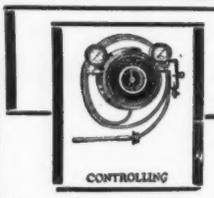

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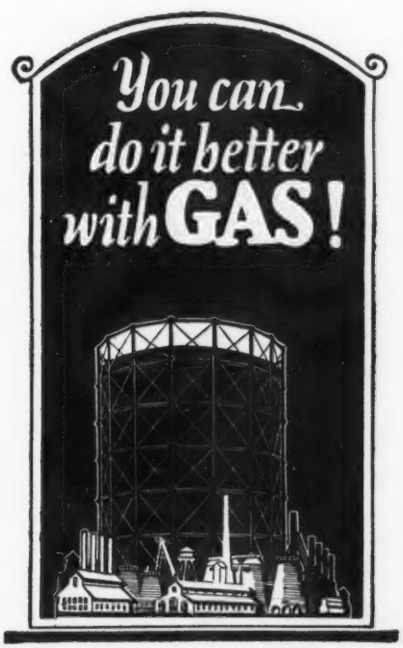

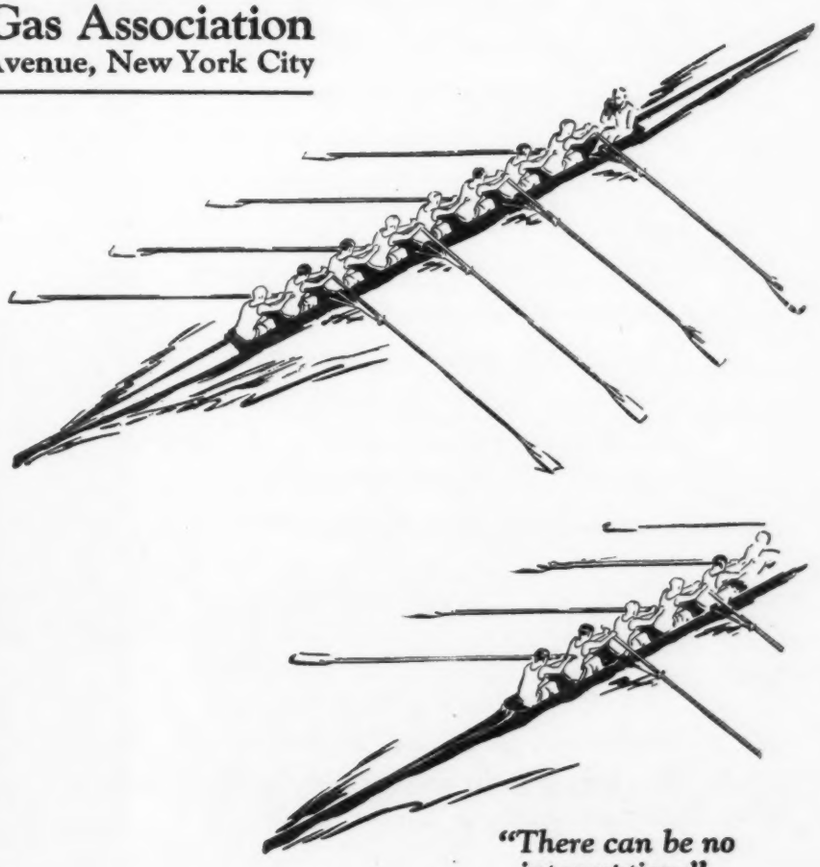

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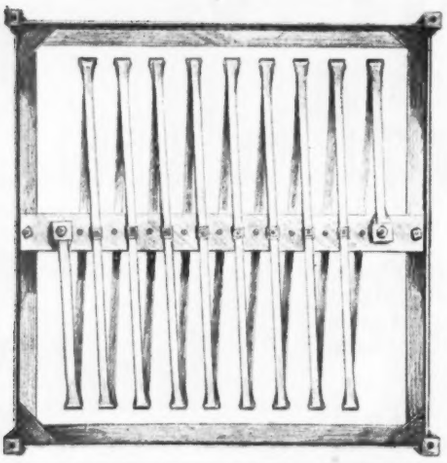
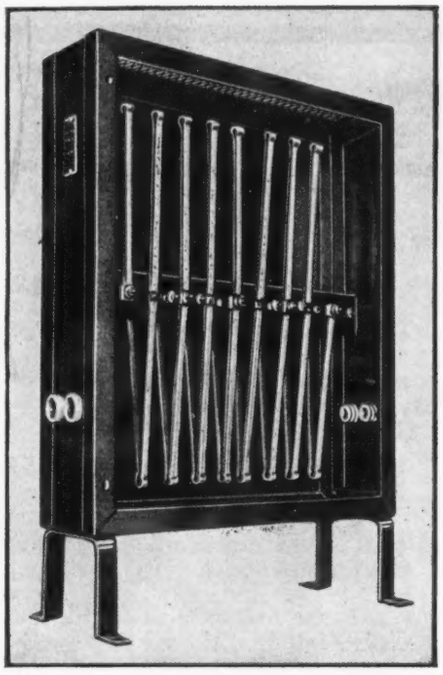
(Right) Enclosed Ribohm Heater with cover removed. (Left) Standard Ribohm Resistor in skeleton mounting frame.





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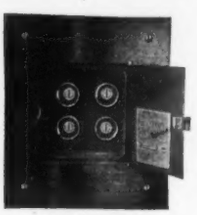

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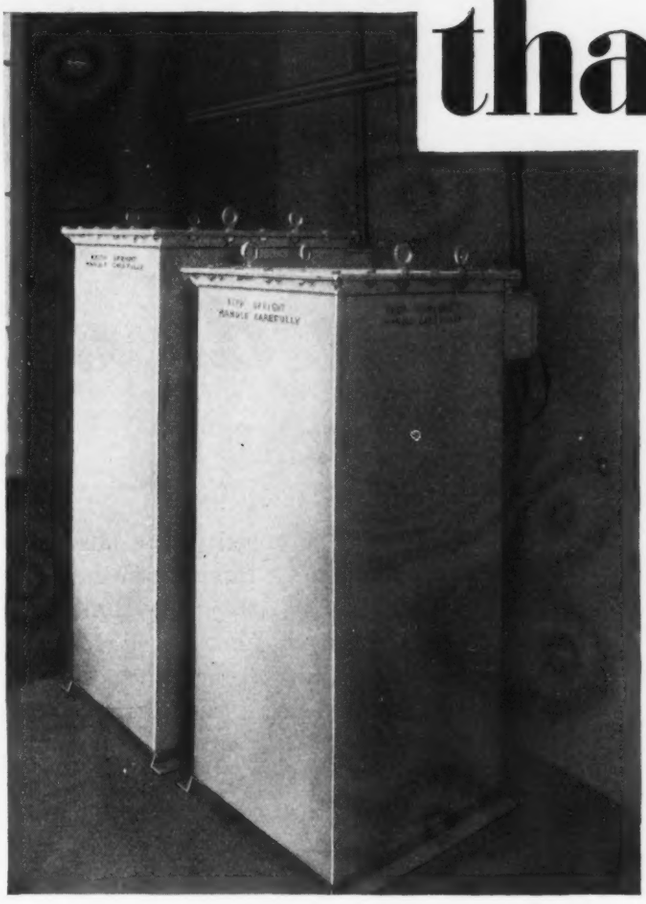

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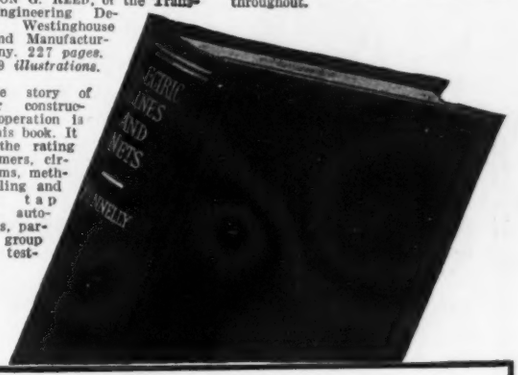

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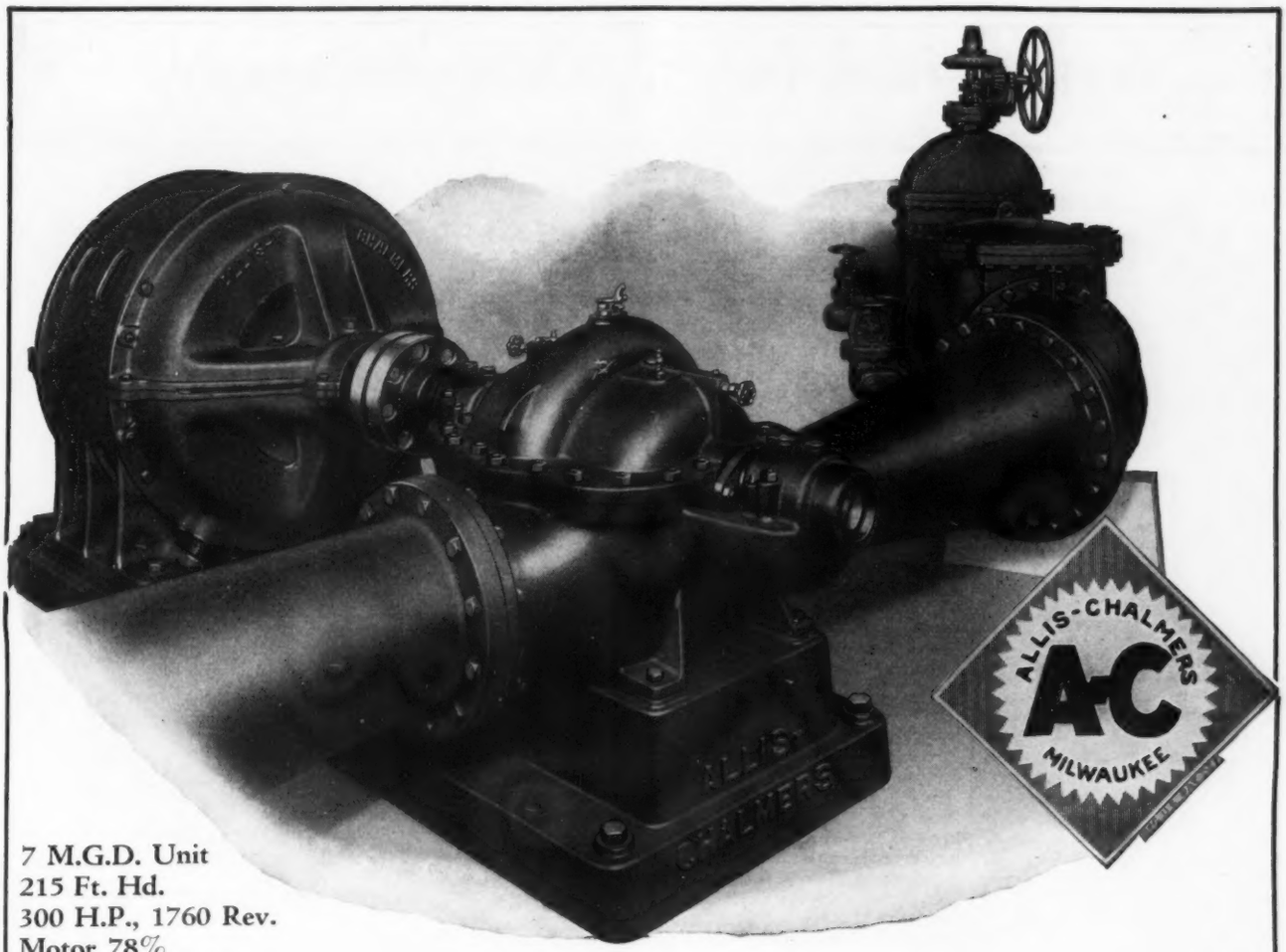

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FROM A TO Z WITH I-T-E

COMING ATTRACTIONS

D *U-Re-Lite All-Steel Distribution Group*—completely enclosed switchboard for nine circuits, 200 amperes each at 440 Volts A. C.

E *Type W circuit breaker*—capacity 100 amperes at 250 volts D. C.—single pole—with time limit overload protection.

F *Type LG circuit breaker*—6000 amperes at 220 volts A.C.—3 pole—time limit overload protection—solenoid operation.

G *Generator breaker*—with direct acting field discharge clips—1600 amperes at 250 volts D. C.—reverse current protection—solenoid operation.

H *Auto U-Re-Lite LL*—1600 amperes at 550 volts A. C.—3 pole—time limit overload protection.

I *Type J circuit breaker*—10 amperes at 110 volts A. C.—single pole—no-voltage protection.

For complete information on dependable protection for any circuit up to 750 volts D. C. or 550 volts A. C., write or call our nearest office.

A Largest circuit breaker ever built—type LG—capacity 45,000 amperes at 750 volts D. C.—single pole—direct acting series overload trip—solenoid operated—non-closable against overload or short circuit, i. e. solenoid trip free at any point of stroke (Autoite)—protects negative leg of entire circuit in electrolytic production of aluminum.

B Type LL—capacity 1600 amperes at 550 volts A. C.—3 pole—3 direct acting series overload trip coils with adjustable time limits (Dalites)—non-closable agains overload or short circuit, i. e. handle trip free (Autoite)—for protection of lighting and power circuits and for across-the-line starting of motors.

C U-Re-Lite Junior—capacity 1 ampere at 110 volts A. C.—used as starting-running switch and overload protection of sensitive candy conveyor.

"What's that? Do we make a complete line of circuit breakers? Why, brother, we make 'em from one-quarter fly power size up to that big 45,000 ampere brute there in the corner! Just keep your eye on this A to Z series of ads and get wise!"

I-T-E CIRCUIT BREAKER COMPANY

19TH AND HAMILTON STS. PHILADELPHIA

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I-T-E PROTECTION

URELITES ~ ~ I-T-E CIRCUIT BREAKERS

The Vallee Station is Lux Equipped

To Prevent Serious Breakdowns Because of Fire

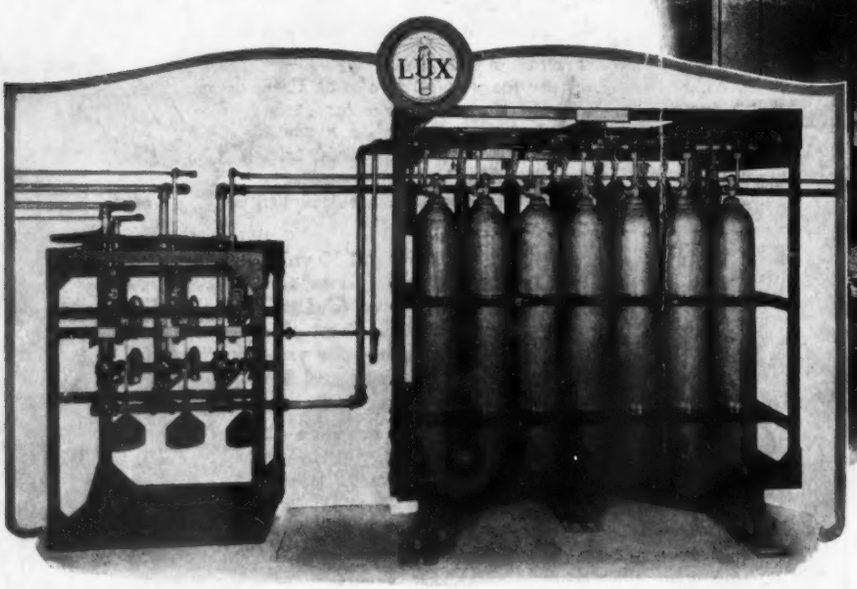
18 Oil switch rooms—the vital spots—in the Vallee Station are protected by the Lux System not only against fire, but against the serious consequences of fire.

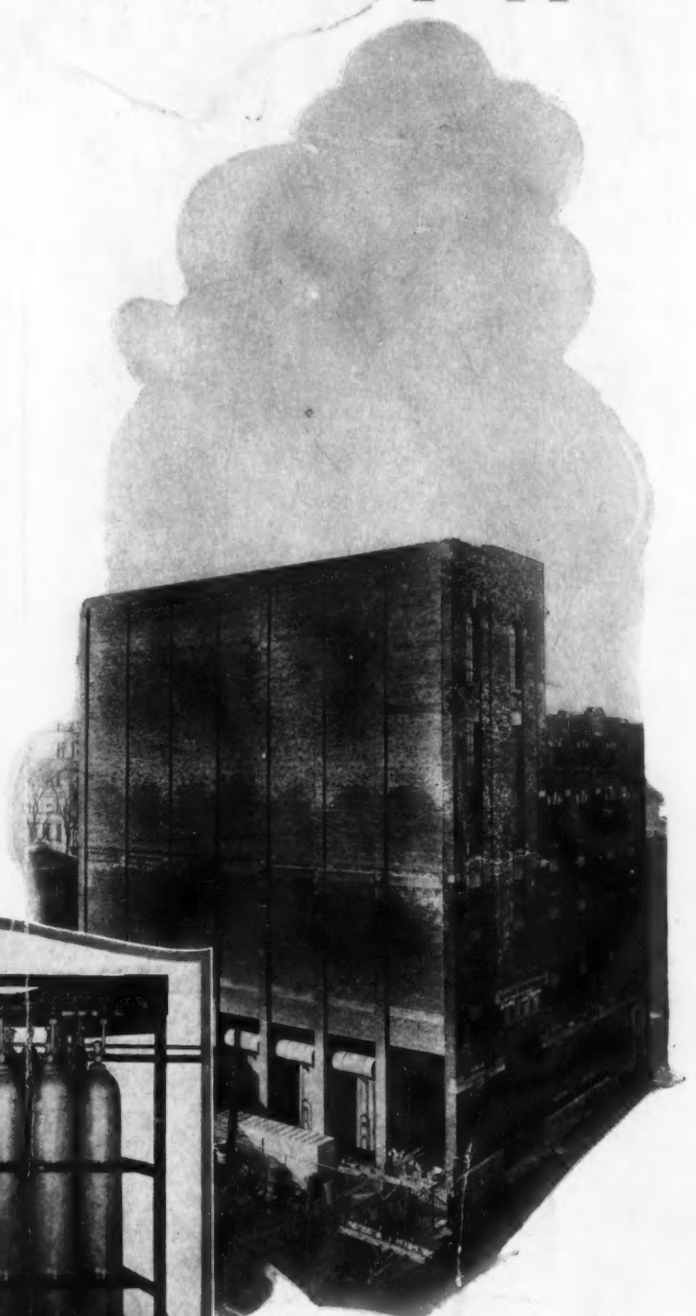
When released, the Lux System fills a burning switch room—from floor to ceiling—with harmless, fire-killing Lux gas. On actual test in Vallee Station, Lux snuffed out fire in less than one minute.

The quick action of the Lux System confines fire damage to the ruptured switch. And its harmless qualities eliminate any injury to adjacent equipment as a result of moisture or chemical action from the extinguishing agent.

Substation engineers, everywhere, recognize that such fire extinguishing prevents serious breakdowns, long operating interruptions and extended inconvenience to customers. That is why the Montreal Light, Heat & Power Company installed the Lux System in their new Vallee Station. . . . . why Lux is used in England, Germany, Italy, Japan and other countries as well as the United States.

Lux will give your substations the same complete protection. Send for information.





The Vallee Station of the Montreal Light, Heat & Power Company where 18 oil switch rooms are protected by one central Lux System.

LUX

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140 Cedar Street
New York

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140 Cedar Street, New York.
Please send me complete details on Lux protection for substations.

Name .....

Company .....

Address .....

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